Multimedia and individualised learning in GCSE English Literature.

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Abstract

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This research aimed to provide insight into the use and possible value of purpose built multimedia computer software for the study of English Literature. The software in question was developed in light of many years practical experience of teaching English Literature to secondary school students preparing for external examinations and was designed with the aim of improving their knowledge and understanding of particular works of literature.

Informed by a critique of the main research findings about ICT use in learning and teaching since the period when computers were introduced into mainstream schools from the 1980s, the empirical research investigated two of the most prominent theoretical and practical perspectives that have been applied to understanding the relationship between educational resources and learning: Learning Styles Theory and Cognitive Load Theory. These two approaches and their associated instrumentation were applied in a quasi-experimental controlled empirical study in four schools in the north-east of England where the multimedia software was used with groups of students embarking on a study of Shakespeare's *Macbeth* for GCSE examination.

Learning Styles theory and the instrumentation used (Kolb's LSI and Honey & Mumford's LSQ) proved less successful than Cognitive Load Theory in demonstrating reliability and validity and therefore in explaining the relationship between different instructional resources and individual learning.

The theoretical integrity and usefulness of these two approaches is discussed and, in particular, the rationale behind the continued use of Learning Styles was explored via interview with school faculty who gave reasons of face validity; the pressure from external inspection; the mechanisms through which they were held

professionally accountable; senior management and institutional policy; the legacy of initial teacher training; and established classroom practice.

Students using the multimedia software demonstrated improvements in their knowledge and understanding of *Macbeth* equivalent on average to one GCSE grade above those not using the multimedia resource and Cognitive Load Theory was found to be successful in explaining this and in predicting the relationship between instructional resource and the learning gains of individuals.

Limitations of the study are drawn along with conclusions for further research and for enhancing teaching and learning with multimedia resources.

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Abbreviations

Throughout this thesis the terms ‘digital technology’, ‘computer technology’ and ‘information and communication technology’ (abbreviated to ‘ICT’) are used broadly and interchangeably to refer to desktop computer technology used by educational institutions (generally but not exclusively within the UK) to access the internet and / or run standalone or networked (e.g. via an intranet as opposed to ‘online’) software programs for the purposes of teaching and learning.

'Multimedia' in the text usually refers to computer applications that incorporate content and media in a combination of different forms - such as text, images, animation, video, and 'interactive' elements within this - that is, elements that may respond in various ways but generally only do so when selected or activated by the user. In this regard multimedia is in contrast to other media that comprises traditional hand-produced or printed material such as text-only or text with illustrations. Throughout this text the term multimedia is most commonly but not exclusively used to refer to its use in computer applications.

Declaration and statement of copyright

The author hereby declares that none of the material presented in this thesis has been previously submitted for a degree and that copyright of the thesis rests with the author. No quotation from it should be published without prior written consent from the author and information from it should be acknowledged.

Appendix 11 contains peer reviewed published articles developed in conjunction with the preparation of this thesis and these include material from throughout the present text.

See:

Appendix 11

Martin, S. (2011) Teachers using learning styles: Torn between research and accountability? *Teaching and Teacher Education*, 26(1), 1583-1591. (Page 287 of the present text).

Martin, S. (2012) Does Instructional Format Really Matter? *Educational Research and Evaluation*, 18(2), 125-152. (Page 296 of the present text).

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Chapter 1 Introduction

```
West of House.
You are standing in an open field west of a white
house, with a boarded front door.
There is a small mailbox here.
```

Although many people today will never have heard of it, this is the opening text of what is arguably one of the most iconic pieces of interactive computer software ever written - and is the place where my journey into the use of computers in education began.

The software in question is the computer-based adventure-game trilogy *Zork!*, which was written in 1977 on a 'mainframe' computer by Tim Anderson, Marc Blank, Bruce Daniels and Dave Lebling, who were members of the Dynamic Modelling Group at the Massachusetts Institute of Technology (MIT)(Anderson, 2008). Published in 1980 by the American software company Infocom, *Zork!* was part of a genre of digital interactive fiction which ran on the then emerging market of commercial computers aimed at the home. Unlike today's computer software which depends upon powerful multimedia machines to function, *Zork!* ran on much more modest technology and featured only white text on black backgrounds; it contained no colour, graphics, animation or sound effects. In the context of *Zork!,* 'interaction' therefore comprised of the user repeatedly responding to the text which appeared on the screen by typing in words at the keyboard and observing the software's response. As one commentator of the time noted:

> "*Zork* is all text - that means no graphics. None are needed. The authors have not skimped on the vividly detailed descriptions of each location; descriptions to which not even Atari graphics could do complete justice."
>
> (Stone, 1983)

Between 1980 and 1984 I worked as Senior Teacher at a large secondary school in Maidstone, a county town in southern England in Kent, in the UK. My main teaching role was in the English Department and as part of this I had a number of classes of low achieving students, comprised mostly of boys, who were preparing to take external public examinations. The low levels of

educational attainment in that particular school during the 1980s were not uncommon, as educational achievement and aspirations in many schools around Maidstone at this time were significantly below national averages.

During this period the UK Government, under both Labour and then Conservative leadership, launched and nurtured the Microelectronics Education Programme (MEP), which ran from 1980 until 1986. The programme was managed by the newly formed Council for Educational Technology and, following the involvement of the Department of Trade and Industry in 1982, saw the introduction of a computer into every school in England. The machines provided for this purpose were Research Machines (380Z or 'Nimbus' machines), BBC 'Acorn' computers and also the Sinclair ZX Spectrum; the latter being most commonly used for control projects, such as teaching children how electronic switches in circuits or traffic lights worked.

At this time one read in much of the literature circulated to schools that the objective of the MEP was to promote the study of microelectronics and its effects, and to encourage the use of this technology as an aid to teaching and learning. When our school's computer arrived, the Head Teacher was disposed to offer it to the Physics department for dismantling and study as part of the study of microelectronics but was persuaded by me to allow the English Department to use it as an aid to teaching and learning instead.

Initially this single Research Machines 380Z computer in my classroom was used for word processing with single students or small groups and when it was eventually supplemented by several additional 'Nimbus' machines this work was extended to larger groups, although the eight machines available still made it difficult for students to be allocated to their own machine and forced students in classes to work together in groups. It became clear later that this restricted availability proved to be an opportunity in disguise.

Whilst the curriculum work done by students with these machines was interesting and unusual, their use seemed to appeal mostly to academically able students who could take advantage of word processing software's ability to format and edit text so as to improve its clarity of expression, eloquence or persuasive power. This suggested that the educational usefulness of computers might largely be related to a student's academic ability in a given subject but it

was equally possible that the technology simply appealed to those students who liked to learn in a particular way because the available software offered opportunities for working in a manner that somehow suited their preferences. As the technology at that time was limited in its ability to present content using different media, styles or formats, it seemed likely that if differences in these things were important for individual student engagement and learning then only those learners for whom that limited range of presentational styles and formats was valuable would be strongly attracted to its use.

The affordances offered by the word processing software being used were insufficient to encourage the majority of my weaker students who struggled to master basic English expression, spelling and grammar; what was unclear was whether this was more to do with the difficulties they were experiencing with the subject content itself or because their preferences for learning in certain ways were not being very well catered for by the software, or whether the ways in which content was presented to learners made a significant difference to learning for all learners, or whether these issues were all closely related.

I therefore became interested in discovering whether successful learning with computers was more likely to be about providing for each individual student's approach to learning (their habitual preferences for how they liked to learn) or about being able to present subject content in particular formats that were intrinsically more likely to lead to learning because of their structure and format. Although there was no computer software available at this time that would allow me to address these issues it was whilst I was thinking of how I might make this technology useful for the students I taught that I came across the software which introduced this chapter. This software (*Zork!)* seemed to offer ways to begin exploring the questions that concerned me about using computers, because it required highly structured learning to engage with it successfully but did not impose particular ways or styles of learning on the user, although it did use a very limited text-based format for presenting content. I therefore anticipated that, like the word processing software we had used, it was likely to appeal only to a limited number of more able students.

It may be helpful here to provide more details of the this software and to give a brief account of policy developments at the time in order to illustrate how the design and operation of *Zork!* produced behaviour in my students that was very

different to that I had observed with word processing software and how this and the current direction of government policy influenced my thinking about how best to use computers to support learning.

Zork I: The Great Underground Empire is the first part of the *Zork!* trilogy and when one lunchtime I showed it to some of the students at my computer club it provoked considerable interest, I suspected largely due to its novelty. Amongst the group that day were some of my less able students who had wandered in whilst looking for something to do to avoid the rain outside and because of their earlier poor learning experience with word processing software it was this group's fascination with this software that particularly caught my attention.

In response to the pleas from my students I allowed them limited access to *The Great Underground Empire* at the end of English class sessions, as a reward for hard work and task completion. I anticipated that it would be useful in this regard only and it did seem to encourage my students, including my less able ones, to apply themselves more to class work although the latter continued to find the work itself difficult to remain engaged with, despite my best efforts to make the content more accessible and relevant.

However, over the following period of a week or so I noticed a pattern of behaviour emerging with regard to *Zork*! Whilst some students were content to use it alone, most seemed to prefer to wait until some of their classmates were also free and then explore it together. As I watched these students, it became clear that something quite interesting was going on.

Zork! has a limited vocabulary and is programmed to interact with the user in particular ways. The user assumes the role of an anonymous adventurer in this computer simulated fantasy world filled with scores of rooms, some containing traps, some containing puzzles. Hundreds of objects are scattered throughout this maze, some of which are valuable treasures, some of which are magical tools. At the heart of the program is a sophisticated piece of software (a parser) which breaks down what the user types on the keyboard into its component parts of speech, assigns each a function and establishes the syntactical relationship between each part. The software responds according to the output from the parser. Simply pressing only the 'Enter' key on the computer keyboard generates the response "I beg your pardon?", for example, so the user is

required to think of what to say to the game's omniscient 'Dungeon Master' in order to access the environment in the game. When the user types words on the keyboard and then presses the 'Enter' key, the parser attempts to match the words and phrases typed (and to some extent their sequence) with its database of coded words and phrases and their relationships to known meanings. It then selects a response based on this analysis and presents this to the user on the computer screen whilst also selecting a 'move' from the software gaming engine to show the user (if relevant) the next section of, or solution to, the maze or puzzle.

Although not powerful by contemporary standards, the parser in *Zork!* is frequently able to present a reasonable if limited approximation to intelligent response that is at times quite amusing and uncannily human, thanks to the skill of the programmers. This interactive element within the software presented students with challenges and a typical encounter often went something like this (user-typed input in capitals):

```
>OPEN DOOR
The door cannot be opened.
>GO WEST
Forest
This is a forest, with trees in all directions. To
the east, there appears to be sunlight.
>CLIMB TREE
There is no tree here suitable for climbing.
>ENTER FOREST
You hit your head against the forest as you attempt
this feat.
>GO WEST
You would need a machete to go further west.
>GO NORTH
Clearing
You are in a clearing, with a forest surrounding you
on all sides. A path leads south.
On the ground is a pile of leaves.
>PICK UP LEAVES
In disturbing the pile of leaves, a grating is
revealed.
Taken.
>OPEN GRATING
The grating is locked.
>HELP
I don't know the word "help".
```

I anticipated that, faced with this kind of interaction, most students would probably give up fairly quickly, especially as the early version of *Zork!* we used

had no ‘save game’ feature, so when students came into the classroom and began a new session, or if their adventurer character ‘died’ in the game, as often happened, they always started right back at the beginning again, standing in an open field west of a white house, with its boarded front door.

To my surprise many of my students did not give up, however frustrating the difficulties became. Instead they began to discuss strategies with classmates and plan sequences of instructions. They began to explore the software’s vocabulary and make lists of words and phrases it ‘understood’ and objects and actions it ‘knew’ about. Inventories of objects and their locations were developed, especially when it became clear that for many situations and places further into the environment certain objects needed to have been located and ‘collected’ beforehand because their possession by the adventurer was required to overcome obstacles, solve puzzles, open doors or pass barriers. They made maps of the terrain and recorded sequences of successful instructions, often in personal diaries or notebooks. They started to look up unfamiliar words in dictionaries, particularly when exploring vocabulary and wanting correct spellings.

The level of vocabulary and the complexity of description and of sentence structure tends to increase as users progress deeper into *Zork!* and the interaction becomes semantically richer (Montfort, 2005). The following is from a section a little further into *Zork!* than the previous extract and is typical:

```
Living Room
You are in the Living Room. There is a door to the
east, a wooden door with strange gothic lettering to
the west, which appears to be nailed shut, and a
large oriental rug in the centre of the room.
There is a trophy case here.
A battery-powered brass lantern is on the trophy
case. On hooks above the mantelpiece hangs an elvish
sword of great antiquity.
>TAKE ALL BUT RUG
Sword:
   Taken.
Lamp:
   Taken.
>READ
Read what?
>THE DOOR
```

```
The engravings translate to 'This space intentionally
left blank'
>LOOK UNDER RUG
Underneath the rug is a closed trap door.
>MOVE THE RUG
With a great effort, the rug is moved to one side of
the room.
With the rug moved, the dusty cover of a closed trap-
door appears.
>OPEN
Open what?
>DOOR
Which door should I open?
>THE TRAP DOOR
The door reluctantly opens to reveal a rickety
staircase descending into darkness.
>GO DOWN
It is pitch black. You are likely to be eaten by a
grue.
Your sword is glowing with a faint blue glow.
>WHAT'S A GRUE?
The grue is a sinister, lurking presence in the dark
places of the earth. Its favourite diet is
adventurers, but its insatiable appetite is tempered
by its fear of light. No grue has ever been seen by
the light of day, and few have survived its fearsome
jaws to tell the tale.
Your sword is glowing with a faint blue glow.
>TURN ON LAMP
The lamp is now on.
Cellar
You are in a dark and damp cellar with a narrow
passageway leading east, and a crawlway to the south.
On the west is the bottom of a steep metal ramp which
is unclimbable.
The trap door crashes shut, and you hear someone
barring it.
```

Faced with scenarios such as this, different groups began to collaborate to explore different regions and assign specialist roles to individuals – mapmaking, vocabulary, strategy and so on. However, not all of my students became involved in every one of these specific activities in every session and it was clear that at different times some students preferred making maps, or creating strategies, or working directly with words, or with words together with pictures. It was difficult to discern any fixed pattern in this from casual observation but suddenly these students began exhibiting higher-order thinking skills and using them confidently when previously they had exhibited no potential for such behaviour in my lessons. Above all, what was most noticeable was the degree of involvement, commitment and perseverance displayed by many students and

their evident sense of achievement and enjoyment in collaborating, learning and working in highly self-directed ways to achieve objectives they had developed for themselves. What remained unclear was the relationship between computer use, content format, individual learning style preferences and successful learning.

I began to wonder if there were ways in which the educationally desirable behaviours of my students might be transferrable to alternative settings (such as my English Literature classes) which were not game or puzzle oriented. Could computer software produce learning benefits from content that engaged the imagination but was more demanding in scope and depth - and was not explicitly a game? My concerns were not about using computers for games or any implied trivialisation of learning in this, for it was clear that my students took *Zork!* very seriously indeed. It was the sustained attention, the seriousness of their application and the associated enjoyment they discovered from intellectual application that I sought to transfer – together with their success in learning. However, one concern was whether the computer would continue to motivate learners once the novelty had worn off? Would it encourage meaningful learning in other contexts and, if so, in what particular ways might it do this? Would different students prefer or need to use such a resource in different ways? Would any learning that took place be manifested in improved examination results or in other affective ways, or would benefits be limited to motivation and enjoyment alone? Would any benefits transpire that could not have been achieved by more traditional approaches? Would using computers produce or encourage any changes in the way I taught and in the ways my students learned? In short, would the use of this technology sufficiently repay the necessary investments of time and resources involved in using it?

Inspired by my early experiences with *Zork!*, I developed my own computer software to help students studying set texts for English Literature examinations at GCSE and A Level, drawing on my experiences in the classroom with students to refine it and take advantage of the increasingly sophisticated multimedia capabilities of home computers to introduce more ambitious programs which made use of graphics, animation and sound as these became more widely available over the next twenty years (see the PC version of the software included as Appendix 8). The initial and subsequent versions of the software proved popular and eventually reached a stage of development where I

published titles for eight of the most frequently set literature texts through a limited company I set up for that purpose. These programs, developed initially as an exploration in curriculum development, are now in use in many schools throughout the UK.

From the beginning the software seemed to be successful from my subjective point of view, but I was concerned to establish whether its apparent effects were real and measurable. Did the use of this multimedia computer software offer pupils valuable learning opportunities that were unavailable in traditional classroom environments and, if so, did these enable a useful variety of approaches to academic work for pupils which improved their learning? From my perspective as a practicing teacher I was not aware of whether there was much systematic research on these matters or not and I had used no published research or theoretical underpinning in the design of the software, nor had I made any systematic analysis of its effects. This would perhaps seem surprising now, but these were early days in the development of home computers, the use of computers in schools, the design of human-computer interfaces and especially the use of multimedia and because of this the training of teachers and of those in service at this time had not embraced their use.

Although in the early 1980s I was amongst the first group of teachers in the UK to use computers in mainstream schools, my early experience had already made me aware that whilst the technology seemed to have great potential for supporting learning it also was likely to have significant limitations. In contrast, many government initiatives then and now seem to rest upon on an almost blind faith in the presence or use of computers to somehow provide solutions to many long-standing social, educational and economic problems. My early experiences of using computers was more nuanced and had already suggested that their benefits were likely to be very dependent upon applying them in specific and particular ways, of which educators in general were only just beginning to become aware. My subsequent experience with the software I developed confirmed this view.

So the questions that first intrigued me in the 1980s remained unanswered at that time and through the 1990s and still seemed to inform much of the discussion in the academic literature I came across in later years. Why these same questions still remained topical and, more importantly, the answers to

them somewhat unclear after twenty years of computer use in schools seemed puzzling, so I decided that a more academic and systematic analysis of the use of my software and of my assumptions about its educational usefulness might be interesting. I therefore embarked on such a study, focussing from the outset on those early issues that appeared to me to be of most importance for learning and teaching English Literature with multimedia:

- Did my use of computer software promote greater learning in my students and, if so, what produced this?
- Do students have individual learning styles that can be measured reliably and therefore used in the design and use of multimedia software?
- Is multimedia software helpful to learning because it can offer content in formats that are better for learning?
- What are the implications of the answers to these questions for classroom practice?

From these I developed a number of more focussed questions and sub-questions with regard to the use of multimedia computer software and the teaching of English Literature for GCSE examinations. The purpose of this study is therefore to explore the usefulness of multimedia software in facilitating individual student attainment in English Literature through the following research questions:

1. What are the educational implications of using computers and multimedia software in schools that have been identified in published research?

2. Can multimedia software enhance student achievement at GCSE level?
    a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
    b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

3. What are the implications for theory, research and practice of using multimedia software as an aid to promoting learning in students studying English Literature for GCSE examinations?

a) What are the implications for practicing teachers in secondary schools?
b) What are the implications for educational theory?
c) What are the implications for research?

Chapter 2 addresses the first research question and discusses the published literature relevant to multimedia use in education and within this identifies the two main areas of study in this thesis. The main issues explored are those identified within early research in the field (up to around 1999); the influence of teacher attitudes towards ICT; the effects of ICT on attainment and pedagogy. From this the first area that is identified is the contribution to theory and practice of two popular instruments for measuring learning styles (the focus of Chapter 3). The second area that is identified is the contribution to theory and practice of Cognitive Load Theory and the application of this to the design and use of multimedia for learning (discussed in Chapter 4).

Chapter 3 draws upon the conclusions from Chapter 2 and outlines the methodology for the empirical work reported in Chapter 4 and Chapter 5. The design, appearance and operation of the multimedia resource used in this study is described and in view of its purpose built nature and the difficulty of visualising it, illustrated examples of typical content are given. The justification is given for the instruments used in the study and the experimental settings and samples used and the limitations of this work are set out.

Chapter 4 addresses research question 2(a) above and discusses the contribution of learning styles theory to our understanding of the relationship between the learner and instructional content. Two commonly used instruments for measuring learning styles are tested in a sample of secondary schools and GCSE English Literature classes and the chapter discusses whether these are able to usefully identify the individual learning styles for students. The actual and perceived value to teachers and schools of these instruments and their measures is explored. The usefulness of and implications for learning styles for the design and use of multimedia software is discussed.

Chapter 5 addresses research question 2(b) above and discusses the contribution to the design of instructional materials made by Cognitive Load Theory and to our understanding of the relationship between the format of learning resources and individual learning. The theoretical underpinning of Cognitive Load Theory is discussed and related to implications for multimedia design. The chapter reports an experimental study conducted in a sample of secondary schools and GCSE English Literature classes to explore the relationship between the format of instructional material, the use of multimedia and individual learning.

Chapter 6 Discusses the results of the empirical work reported in Chapters 4 and 5 in light of the findings from the literature review in Chapter 2 and the research questions. It then draws upon previous chapters to address the third research question and discusses the implications of the work reported here for practicing teachers in secondary schools, for educational theory and for future research.

Chapter 2 - Literature review

2.1 Introduction

At the end of Chapter 1 a number of questions were asked:

1. What are the educational implications of using computers and multimedia software in schools that have been identified in published research?

2. Can multimedia software enhance student achievement at GCSE level?

    a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
    b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

3. What are the implications for theory, research and practice of using multimedia software as an aid to promoting learning in students studying English Literature for GCSE examinations?

    a) What are the implications for practicing teachers in secondary schools?
    b) What are the implications for educational theory?
    c) What are the implications for research?

This chapter addresses the first research question and examines the published literature relevant to ICT use in education and within this identifies the two main areas of empirical study in this thesis. The main issues within early research in the field are discussed, followed by the influence of teacher attitudes towards ICT and then effects of ICT on attainment and pedagogy. From this the first area of particular study that is identified is the contribution to theory and practice of two popular instruments for measuring learning styles (research question 2(a) and the focus of Chapter 3). The second area identified is the contribution to theory and practice of Cognitive Load Theory and the application of this to the design and use of multimedia for learning (research question 2(b) which is discussed in Chapter 4). Research question 3 is the focus of discussion in Chapter 6.

The discussion in this chapter examines research literature most relevant to the focus of this study and draws on published work from around the time computer technology was introduced into schools in the 1980s and begins with a review of related developments in national policy. The latter is of particular relevance because government policy and associated spending have been the main drivers that brought computers and other digital technologies such as the internet into UK classrooms to a significant degree and because governmental decisions in these areas have had important effects on how computers came to be used. Following this is a summary of some of the main research findings about the adoption of ICT by teachers in the intervening years and a review of some of the main theoretical and empirical work to come out of this. The discussion then summarises the key issues, especially for multimedia, that have been identified and these are used to refocus the questions framed in the Introduction (Chapter 1) into the research questions used in this study.

2.2 Teacher training and the curriculum

When I was preparing to become a teacher during the early 1970s, teacher training commonly included exposure to the study of the history of education, to educational philosophy and to the writings of those interested in curriculum development. Aspiring teachers at this time were also introduced to the idea that a learner-centred approach to classroom pedagogy was more desirable and effective than one centred on the teacher. As a consequence of this, teacher training in this period commonly included reference to the writings of thinkers such as Dewey and his arguments that students in schools needed to both experience and interact with the educational curriculum and should therefore become collaborators in partnership with teachers in the experience of learning. However, Dewey was also esteemed for his advocacy of the need to maintain a balance between an active child-centred approach to pedagogy that took account of the experiences and interests of the pupil as well as the need to respect the important role of the teacher in drawing meaningfully upon the pupil's prior learning and in choosing and presenting important curriculum content (Dewey, 1900; 1902).

These approaches to learning and teaching had been given impetus by publications such as the Plowden Report (HMSO, 1967) which, although

focussed largely on the primary sector, was seen to hold important lessons for education more widely, as reflected in its opening comments:

> At the heart of the educational process lies the child. No advances in policy, no acquisitions of new equipment have their desired effect unless they are in harmony with the nature of the child, unless they are fundamentally acceptable to him. We know a little about what happens to the child who is deprived of the stimuli of pictures, books and spoken words; we know much less about what happens to a child who is exposed to stimuli which are perceptually, intellectually or emotionally inappropriate to his age, his state of development, or the sort of individual he is. We are still far from knowing how best to identify in an individual child the first flicker of a new intellectual or emotional awareness, the first readiness to embrace new sets of concepts or to enter into new relations.
>
> (HMSO, 1967, p. 7)

Trainee teachers were encouraged to apply such ideas as well as those of Dewey (1900; 1902), Cole et al (1978) and especially Piaget (1928; 1985), whose thinking clearly influenced Plowden. Piaget suggested that through a process of objectification, reflection and abstraction children develop their own schemas (mental frameworks of structured groups of concepts), complex predictive models and their understanding of their physical and social environments and that they do this through exploration and the iterative use of abstract reasoning to deduce 'rules' operating in a particular environment or setting (Piaget, 1928, 1985). Teacher training programmes encouraged this approach as an effective way to develop a more child-centred pedagogy and also promoted Vygotsky as an influential related thinker and in particular referred to his work on the role of play in facilitating the development of abstract ideas and meaning; the part these have in developing a child's higher mental functions were much in evidence in professional discourse at the time (Cole et al., 1978). Vygotsky also identified the important social role of collaborative learning and related this to his concept of the 'zone of proximal development' in the advancement of individual learning through collaboration. These ideas, together with those of Piaget and Dewey, featured strongly in the newly emerging honours degree programmes of teacher training that I and my contemporaries experienced but were also subject to cautions about the use of ICT from the literature of the time which observed that children in their early school lives learn to accept “delay, denial and interruption of their personal wishes and desires” (Jackson, 1968, p. 18). Teachers in classrooms of the time were mainly concerned to "decide on a set of activities" and then "focus their

energies on achieving and maintaining student involvement in those activities" (ibid, p. 162). Writers still felt the need to continue to make a similar point almost forty years later:

> "New technology's potential to change the culture of the classroom and the relationship between teacher and students is important, since traditional classrooms are not ideal learning environments."
>
> (Somekh, 2007, p. 98)

My own professional training and experiences with ICT, particularly with *Zork!*, (Chapter 1) had therefore left me sensitive to the possibilities offered by this newly available technology and its potential for promoting collaborative and individual learning, for encouraging pupils to take more control of their learning to collect and synthesise information thoughtfully, for promoting the development of critical thinking and for developing intellectual constructs and theories about scenarios and relationships. As a result of my training and early experience with computers I was persuaded of the superiority and desirability of a more student-centred and experientially-based approach to learning and teaching and excited by the possibility that ICT may be a powerful way to bring these things about. This was not a unique experience, and many of my contemporaries during the 1980s and 1990s who started incorporating ICT into the classroom practice found that its use allowed the historical continuity of teacher-centred pedagogy to be replaced by more student-centred approaches (Cuban, 1993).

The supporters of Plowden and the advocates of collaborative and student-centred learning were, however, not without influential and powerful opponents who had been growing in prominence since the 1970s. Some commentators and politicians mounted a concerted drive against such approaches - even though their grounds for doing so often appeared to rest largely on dogma and opinion and tended to ignore evidence contrary to their agenda – and accused child-centred approaches and the dominance of what they dubbed as 'trendy educationalists' of being responsible for what they identified as a decline in educational standards (Scruton, 1987). Piaget's ideas of cognitive development through step-wise stages where learners developed through their own active efforts informed much of the Plowden Report and against this rising criticism the recommendations of both Plowden and therefore of Piaget fell out of favour (Halsey & Sylvia, 1987). The 'Black Papers' of 1969 added fuel to the debate in

blaming much of what was seen by their authors as wrong with education on the influence of Plowden (for example see Cox & Dyson, 1969). Difficulties surrounding a small number of problematic and idiosyncratic schools, such as at the William Tyndale school in North London in 1974 (Gillard, 2011), exacerbated matters and were seized upon by these critics of education and as a result of all this Plowden came to be increasingly marginalised.

The then Prime Minister Jim Callaghan's 'Ruskin Speech' at Ruskin College, Oxford in 1976 also marked a turning point in these debates and the emergence of more overt political control of the curriculum and teacher pedagogy. There was a prevailing view in many teacher training institutions in the late 1970s, including the one I attended, that this firmer tone signalled a clear intention to take action and was probably due to frustration at what some politicians saw as the stubborn reluctance of teachers and schools to listen and change. From 1979 onwards the Conservative government, led by Margaret Thatcher, embarked upon a process of political intervention in education that led to the imposition of a subject based National Curriculum in the 1988 Education Reform Act.

The relevance of all this for the present study is that within the National Curriculum ICT then emerged as an important area that all subject teachers were and still are required to address (and Ofsted is required to inspect) that was and continues to be characterised largely by ‘key concepts’ such as: individual capability in ICT use; communicating and collaborating; exploring ideas and manipulating information; understanding the impact of ICT; and thinking more critically about using ICT and information in general. The National Curriculum indicates that these key objectives should be achieved through the development of 'essential skills and processes'. Teachers, such as those of English Literature at Key Stage 4, are for example required to promote the use of ICT for: 'Finding information'; 'Developing ideas'; 'Communicating information'; and 'Evaluating information' (QCA, 2007). The National Curriculum emphasises the use of ICT for generic instrumental purposes and promotes its utilitarian purpose across the curriculum. In this regard the use of ICT by pupils for finding information, developing ideas, communicating information or evaluating their own work is not unlike the way such objectives might be achieved by a teacher through the use of writing, classroom discussion, promoting the reading of books or by getting their students to use a library.

The introduction of ICT into schools in the 1980s therefore coincided with a more overtly interventionist stance by politicians towards mainstream public education and also with the fall-out from the continuing ‘great debate’ about the curriculum and the nature, purposes and responsibilities of teachers and schools. However, my own early experience, particularly with *Zork!*, had by this time led me to already conclude that the 'catch all' utilitarian approach for the use of ICT that seemed to run so strongly through government policy and the National Curriculum was unlikely to discover or exploit many important features that may be unique to this technology for enhancing learning and teaching in specific ways and in particular contexts.

2.3 National policy and ICT

During the period of my early experiments with *Zork!* and my first attempts to develop my own software to support the teaching of English Literature in the 1980s, the UK government was busily promoting the wider use of computers in schools. At first this was via the Microelectronics in Education Project in 1980 but this was joined by a range of other, often heavily funded, initiatives.

The transformational promise of digital and other technology for education had been an enduring feature of political rhetoric long before Michael Heseltine launched the Superhighways initiative in the UK in 1995. Digital technology has been consistently offered to the public by politicians as an almost magical talisman for producing educational progress and excellence ever since. The sums of money committed though this field of public policy have been substantial, even when only the major events and policy initiatives since 1980 are taken into account (Table 2.1).

Table 2.1 Major financial initiatives for schools 1980-2002

Source	Year	£ (million)
The Microelectronics in Education Programme (MEP)	1980-1986	32
The Micros in Schools Schemes *	1981-1884	15.1
The Technical and Vocational Educational Initiative (TVEI)	1983-1987	240
Microelectronics Education Support Unit (from 1988-1998 merged with the National Council for Educational Technology)	1986-1988	13
The Education Support Grant for England **	1987-1993	90
Multi-media computers in primary schools	1992-1995	10
Education Departments' Superhighway Initiative (EDSI)	1996-1998	10
Multimedia laptops for teachers	1996-1998	27
The National Grid for Learning (NGfL)	1998-2002	700+
Training for teachers and librarians (New Opportunity Fund) ***	1999-2002	230
Total		1,367.1

* Provided by the Department of Trade and Industry (DTI) who continued to add further funding each year throughout the 1980s from surpluses at the end of their financial year.

** Supplemented since 1993 from the Grants for Educational Support and Training (GEST) scheme.

*** £1.125 billion total spend on this programme, making the overall total over £2.5 billion

Many of the problems that dogged the ambitious policies for ICT launched in the 1980s and thereafter, especially those resulting from an over-emphasis on hardware at the expense of teacher training, should have been predictable on the basis of research and evaluation that had already been done (House, 1974). During the 1980s the damaging effects of failing to draw upon prior research was exacerbated within the Department for Education and Science and the Department for Trade and Industry by a disinclination to commission any evaluation of the then current initiatives (Somekh, 2000).

'Technology' policy initiatives at this time (and also, many would say, those launched subsequently) were also characterised by political desires for tangible success in often unrealistically short time-scales. The promotion of a 'bidding-culture' for resources also often tended to encourage inexperienced individuals and organisations to rush into offering things that turned out to be unattainable. For the ten years from 1987, when initiatives faltered or failed, the DES was under such pressure to deliver on promises made to and by Ministers that key personnel were blamed and "less experienced people were brought in because they were prepared to offer more than could actually be achieved" (Somekh, 2000, p. 23). The situation improved in the 1990s with the formation of the National Council for Educational Technology (NCET; funded by the DES) which

was required to consult the research community. However, there were still some problems and, to take one prominent example, the major Teaching and Learning Technology Project was in danger of never being evaluated "probably because of a fear that it might indicate a considerable waste of public money" (ibid, p. 24).

The National Grid for Learning (NGfL) was the single largest contributor of resources for technology to education in the UK and was developed to meet two of the three recommendations of the Independent ICT in School Commission's Stevenson Report (1997) - the first of which being to improve teacher training and the second being about the provision of up-to-date computers and the formation of a network to allow teachers to exchange professional information. The NGfL was focussed on promoting higher levels of practical competency in teachers' use of digital technology and on the provision of hardware and infrastructure. Notably, therefore, the NGfL was developed without an explicit overriding educational outcome in mind and in common with many of the initiatives before it, without the support of a body of research underpinning the specific outcomes for pedagogy and student learning that could reasonably be anticipated.

Like many of the initiatives from the 1980s, the NGfL seems to have been based on a belief that teachers would welcome such initiatives and changes, that these would enhance classroom practice and that teachers would therefore be keen to embrace opportunities to gain expertise in the use of new technology:

> "Teachers rapidly become enthusiastic once they have regular hands-on access to computers"
> (Independent ICT in School Commission Report, *The Stevenson Report*, 1997, p. 7)

The Commission also offered two further key observations:

> "we do not advocate Central Government ordering large amounts of hardware for schools" (ibid, p. 9)
>
> ICT "… should be used in the service of the curriculum, and made available to help teachers to manage the learning process, however that is defined by them." (ibid, p. 15)

The Stevenson Report was not alone in advising caution in the introduction of ICT into schools and emphasised that such change could be perceived by teachers as threatening, especially as it involved the introduction of highly technical and expensive machines which seemed set to alter the nature of teaching. Introducing effective change in education is often about changing beliefs and attitudes more than anything else and neglecting this has thwarted many interventions:

> "… if ever there is an example of the risk of "death by a thousand initiatives" it is teacher training! It is difficult to blame and easy to sympathise with the consistently critical - and exhausted! - feedback we have received about the number of knee jerk changes made to teacher training. *Changes should be made to the training of teachers to encourage the use of ICT only if Government has a genuine and clearly stated belief about the huge importance of ICT*." (ibid, p. 22 emphasis in original)

However, other commentators noted that the government's communication of its belief in the importance of ICT was a necessary but insufficient precondition for the successful introduction of technology into schools and that earlier lessons should not be forgotten:

> "Those who introduce change treat teachers in precisely the same way as they criticise teachers for treating students. Curricula are often introduced in a way that ignores what teachers think and why."
>
> (Fullan, 1982, p. 119)

Such concerns were also echoed in the evaluation of the Teaching and Learning Technology Programme, conducted by Coopers & Lybrand, the Tavistock Institute and the London Institute of Education, who found that:

> "… existing (ICT) products need to be embedded into teaching and learning structures for students. This requires the addressing of issues such as cultural change within departments, time for academics to work CBL (computer-based learning) into their teaching curricula, staff development and training and even a fundamental change in the role of teachers in some higher education institutions."
>
> (Coopers and Lybrand et al, 1996, as cited in Somekh, 2007)

In contrast to Stevenson's view that teachers generally welcome both change and the introduction of ICT (Independent ICT in School Commission, 1997), other writers argue that teachers are commonly perceived as opposed to change, that many of them see ICT as just another bandwagon or unwelcome experiment and that many of them feel such encroachments on their practice can safely be ignored because they have little impact on reality; in this view teachers are seen as exercising a sort of practical wisdom (Dawes, 1999). Given that in the event the government ordered large amounts of hardware for schools, made little attempt to involve teachers in defining how it should serve the curriculum and appeared to ignore cautions from writers such as Fullan (1982), it is easy to see how an unflattering view of teachers may have gained currency in the minds of some policy makers and politicians.

The seeming preoccupation with the provision of hardware and skills training was not unique to the UK. Similar political imperatives and developments occurred elsewhere and had in common with the UK context an injunction that schools should spend more on computers, with the accompanying expectation that this would improve students' academic achievements. For example, in 1997 in the United States the President's Committee of Advisors on Science and Technology and Panel on Educational Technology advocated a three-fold increase for public spending on resources and services related to technology, most of which was to be for equipment and technical infrastructure (Culp et al., 2003).

In 1998 the United States spent $7.2 billion (2.7% of the total spending on education) on computers in schools, mostly on hardware (74%), although many government advisers and several major reports sought a much greater proportion on software. The five year spend from 1994-1998 was approximately $29 billion (although by 2001 in real terms this was probably no more than $175 per pupil per year) and some observers argued strongly that this was inadequate: "Until spending levels rise substantially, the impact on students is likely to be severely constrained" (Anderson & Becker, 2001, p. 19).

Commentators have pointed out that underlying judgements were being made in decisions to spend money on computers as opposed to other resources and have, in contrast to the technology's arguably unproven worth, drawn attention to research concluding that traditional approaches, such as reduced class size

and increased teacher training, confer recognised and substantial achievement benefits for pupils. For example, the total cost of introducing computer aided instruction (CAI) in Israel between 1994-1996 has been equated to one additional teacher per school per year, and similar resource commitments in other countries have occasioned comment that “this significant and ongoing expenditure on education technology does not appear to be justified by pupil performance results to date” and that “on balance, it seems money spent on CAI … would have been better spent on other inputs.” (Angrist & Lavy, 2002, p. 761).

Despite similar reservations from observers in the UK, in 1999 the New Opportunity Fund (NOF) continued the impetus of the NGfL and, using funding from the National Lottery, began training teachers in the use of information and communication technology. Commenting on the scope of this initiative and its anticipated outcomes the Chair of the Fund, Baroness Pitkeathley, said:

> "I am delighted that our ICT training programme has made a strong start. Eight hundred teachers will potentially have the opportunity to undertake training in the use of ICT in the classroom this term. We expect many more to start in September, and we will fund training for all teachers and school librarians who need it by 2002."
> (http://www.prnewswire.co.uk/cgi/news/release?id=59794)

The express aim of the NOF was to ensure that teachers made effective use of technology and the expectation was that this would "make a significant contribution to the raising of standards of pupils' achievements” in ways “that meets their needs and is delivered in a way which fits into the culture and plans of their school" (ibid). Details of how these objectives were to be attained in practice were not provided.

Many political initiatives for greater ICT use in education, whether originating in the UK or elsewhere, seem founded more on aspiration than on research findings when politicians, government organisations and policy makers are presenting them to the public. Early failures to commission evaluation studies of the impact of ICT provision compounded the impression that political action may have been judged more important by policy makers than the cautious and more measured implementation suggested by observers such as Stevenson (Independent ICT in School Commission, 1997).

The introduction of ICT into schools may be seen as being designed to fulfil a number of goals: manufacturers desire profit from selling equipment to schools, whilst others may be seeking solutions to the problems perceived by them to have historically crippled education. Another group may anticipate that ICT will create a revolution in classroom teaching practices; and yet others do not wish to see poor and minority children left behind in technological expertise. Such coalitions seem to be generally driven by a belief that if ICT were introduced into the classroom it would be used and if it were used it would transform education (Cuban, 2001). The main impetus for such development in both the USA and the UK appeared to be the interactions between a changing job market and the anticipated effects of the developing global economy, about which President Bill Clinton observed:

> "Frankly, all the computers and software and Internet connections in the world won't do much good if young people don't understand that access to the new technology means … access to the new economy"
>
> 'President Clinton lauds connection of business, community firms to give $100 million for Internet access', *San Jose Mercury News*, Silicon Valley, California. April 18, 2000 http://www.mercurynews.com/

In this President Clinton was echoing a similar sentiment from Prime Minister Tony Blair:

> "Children cannot be effective in tomorrow's world if they are trained in yesterday's skills. Nor should teachers be denied the tools that other professionals take for granted."
>
> (Department for Education and Employment, 1997, p. 1)

However, the economic imperative for adopting new technology in education may rest upon a misreading of its probable role, an incorrect assumption about the need for workers to have ICT skills and a lack of consensus about what those skills might be and about their precise economic or educational utility. The promotion of the technology has tended to be dominated by deterministic views of education heavily characterised by simplistic 'cause and effect' assumptions about anticipated benefits (Selwyn, 1999; Cuban, 2001).

Cuban also found that even in very high-technology contexts, many skilled teachers are strongly inclined to use ICT primarily to replicate their existing

teacher-centred instructional practice (Cuban, 2001). Dawes' early study of these phenomena classified teachers as either 'potential', 'participant', 'involved', 'adept' or 'integral' users, depending on the degree to which they integrated ICT into their practice (Dawes, 1999). Whilst Dawes presumed the category into which teachers fell was influenced by curriculum specialism (e.g. science teachers may find ICT more intrinsically useful than PE teachers), she also noted that even with the more specialist curriculum used with older children, where more teachers were in the higher categories, few ever reached further than 'involved' practitioner status (Dawes, 1999). Follow-up studies of such work have tended to concur and have further concluded that frequent use of ICT is confined to a small minority of educators, although teachers' access, technical competence and an orientation toward a constructivist pedagogy in which depth of study is emphasised more than breadth can significantly affect whether teachers are likely to use ICT (Becker, 2000). Teacher attitudes towards ICT as driven by their enthusiasms, values and existing pedagogy would therefore appear to be important for understanding how far and how successfully the technology is likely to be adopted and applied.

2.4 Attitudes

During the latter half of the twentieth century digital technology was frequently presented as an exciting solution to a range of educational and social concerns and also as a means by which teachers could adopt educational roles very different from their perceived traditional didactic stance as the transmitters of knowledge (Loveless et al., 2001). Such changes were thought to be desirable in part because they could enable a more student-centred approach to classroom practice which had long been seen by many as more appropriate and effective (Dewey, 1900, 1902; Piaget, 1928, 1985; Coopers & Lybrand, 1996; Cole et al., 1978) and also because the ability of ICT to offer easy access to a huge range of contemporary information was seen as presenting an effective challenge to the view of knowledge as something that was static and fixed (Loveless et al., 2001).

A powerful limitation on the use of computers by teachers may therefore stem from their beliefs about the nature of student learning and, leading from these, what type of instruction is best for their pupils; beliefs that are influenced by their own theories about learning and the affordances that are offered by ICT

applications (Becker, 2000; Ravitz, Becker & Wong, 2000). For example, as a result of such beliefs, some teachers may feel that the internet is largely irrelevant to what they are concerned with in classrooms and, unsurprisingly therefore, may feel that its use is of little relevance to their academic values or pedagogy. Some teachers have also argued that in any case they are too busy with many other initiatives to find time to use ICT, have no real knowledge of how best to use it and are dissuaded from considering doing so by the expense and time for training, the scarcity of ICT resources, a lack of technical support and in some cases also by the unfavourable attitude of their school's senior management (Dawes, 1999; Williams et al, 2000).

In addition, it has also been argued that the most productive use of ICT is usually made by those teachers who are uncomfortable with transmission-oriented pedagogy, even though this approach appeals to policy-makers and many of the wider public because it is assumed to produce higher standardised test scores and improved public examination results (Becker, 2000). Becker argued that these productive users of ICT instead prefer to develop a more constructivist pedagogy which emphasises the student's experience and response to learning and their insight into the subject, each of which is not normally sympathetic to covering large amounts of curriculum content – in large part because it requires significant amounts of time and teacher expertise. This led Becker to conclude that:

> "In academic subjects, we would predict that teachers who believe in a more traditional transmission-oriented approach will find most applications of computer technology incompatible with their instructional goals, and will therefore use a more limited range of computer applications"
>
> (Becker, 2000, p. 10)

So whilst teachers who make most use of ICT have been found to have consistently more constructivist approaches than average for teachers and whilst having such an approach increases the chance that they may use ICT, it rarely results in them consistently selecting particular types of computer work for their students (ibid). The only type of software found by Becker to be used frequently even by 'high-constructivist' teachers was word processing and, in general, many teachers tend to strongly favour classroom approaches characterised by knowledge transmission from teacher to student – indicating that many have inherited 'culturally normative' beliefs about learning which they

would have experienced as part of their own learning but also that “teachers are much more constructivist in philosophy that they typically are in actual practice” (Becker, 2000, p. 22). This echoes earlier observations that most teachers in classrooms are mainly concerned with “achieving and maintaining student achievement in activities” and that children from their early school lives onwards learn to accept “delay, denial, interruption, and social distraction” (Jackson, 1968, p. 162).

However, a study conducted in New Zealand and published in the same year as that by Becker reported that although classroom pedagogy was more commonly constructivist, they found a very pronounced difference amongst teachers using ICT, most of whom typically adopted more neo-behaviourist, mastery-learning based (Parr & Fung, 2000). Parr and Fung also noted that although ICT was expensive - especially the integrated learning systems commonly in use at that time - studies demonstrating their cost effectiveness were lacking. They also observed that the use of ICTs in education gave highly variable results and that knowledge gained by students did not appear to generalise well to the school curriculum or to learning outcomes desired by assessment (Parr & Fung, 2000).

On the other hand, Becker did note that school level characteristics, such as whether computers occupy a central place in the school’s ethos or the attitudes of senior management, may be important in helping or hindering teachers move towards a constructivist pedagogy although on their own seemed unlikely to override the dominant relationship between teachers’ philosophical preferences for either a more transmissive or constructivist practice and the effect of these preferences on whether they use computers with students, their objectives for any such use and their preference for any particular type of software.

According to Becker, many teachers identified ‘getting information’ and ‘skills’ as being the most central objectives of their computer use with students, with higher order skills or learning objectives such as ‘collaborating with others’ or ‘learning to work independently’ being rated as much less important. Word processing and other ‘office’ tool software applications also tended to be by far the most commonly used applications by teachers generally, with 38% of secondary English teachers citing it as their main use of ICT, followed by use of the World Wide Web (12%), CDROMs (10%), graphics packages (6%), skill practice games (4%) and presentation tools (4%) as compared to the use of

simulation/exploratory environments (2%), spread sheets (2%), email (2%) or multimedia (2%) (Becker, 2000). This study of over 4,000 teachers and over 1,100 schools across the USA also concluded that "with overall patterns of software use like these numbers suggest, Cuban's major claim …" (about ICT being predominantly used for replicating existing practice) "… is clearly supported" (Becker, 2000, p. 16). Becker's study concluded that when circumstances are favourable the sustained and thoughtful use of computers brings about a more constructivist pedagogy and this study draws attention to the important necessity for both teacher and school level characteristics to be present during this process. 'Favourable' circumstances may also include continued use and accommodation brought about by the passing of time – many of the teachers in Becker's study had, for example, made regular use of computers over a three year period. Becker found that the exposure of teachers to technology can encourage them to critically examine their educational philosophy and established classroom practice and can facilitate a change to even very strongly held attitudes about pedagogy, as I found during my own experiences with *Zork!* and when demonstrating its possibilities to other teachers (see also Martin & Vallance, 2008).

It seems clear that teachers' subscriptions to a particular pedagogy are a necessary but insufficient condition for changing traditional teaching practices and other writers have observed that changes to assessment systems and a lot more professional development will also be needed (Lim & Chai, 2008). In addition to this, the issue of technology adoption and its relationship to the learning outcomes desired by assessment that was highlighted by Parr and Fung (2000) has provided conflicting guidance.

2.5 Effectiveness, learning outcomes and attainment

Evidence for the effectiveness of the classroom use of ICT, in terms of impact on academic performance, has been mixed over the last 30 years. Different studies have found moderate effectiveness, minimum effectiveness and no effectiveness. Some reports and studies have focussed on the broader impact and effectiveness of ICT, others on game-based learning but relatively few on multimedia. Some observers of the field have argued that effectiveness statements are often of little use in any case because too often they are unaccompanied by details of student ages, the software used, the outcomes

sought and information about how the studies were done (Kikpatrick & Cuban, 1998). Additionally, according to such writers, most policymakers, practitioners and parents do not appear to have examined research and seem to have taken for granted that computers are effective and have then acted to put them into schools (ibid).

One empirical longitudinal study from early in this period by Breese (1996) avoided many of these problems and compared ICT use and non-ICT use groups to establish effects on competencies and skills (in this case in writing) and reported significant persistent benefits from technology use. Breese did not attempt to explain how these benefits arose but simply to demonstrate that they did so over a 20-month study, although it seems likely that improvements in writing quality and syntactical maturity are likely to have resulted from the affordances available within word processing software for easy revision, redrafting and reviewing. The writing of students using word processing software improved rapidly in terms of syntactical structure and quality as measured by awareness of audience, commitment to task, internal logic of writing, creativity, vocabulary and flexibility and appropriateness of chosen style. The students in this study not using ICT failed to reach the performance level that those using ICT had attained at end of the first term, even after five terms (Breese, 1996). However, controlled or experimental studies such as this were relatively uncommon at this time.

From the first appearance of computers in schools, three things have made it difficult to evaluate their contribution: this lack of clarity in the research about what ICT 'effectiveness' means and how it should be measured; a lack of research that has compared computer use with other educational options not involving computers; and different assumptions that have been made in the research about the role of the teacher in technology-rich classrooms. These things have made it hard to compare different research, synthesise the results or reach conclusions, but attempts to do so (such as the 1998 study by Kikpatrick & Cuban, mentioned above) found that by the late 1990s, *single studies* made up a high percentage of the investigations. These single studies of achievement gains or improvements in student attitude reported positive, negative and mixed outcomes from ICT use in roughly equal measure. Kirkpatrick and Cuban did identify several studies that focussed on distance learning or on applications for disabled or at-risk students, all of which reported

positive outcomes, but they noted that few of these studies were rigorous and ten of them that examined the use of ICT in core curriculum areas ranged from being wildly enthusiastic to cautiously pessimistic; beyond this they were unclear in their conclusions.

Ten *Meta-Analyses* were also found by Kikpatrick & Cuban (1998) from the period between 1995 and 1997 that attempted to resolve the problem of small sample sizes found in the single studies by pooling many single studies to create a large sample size. This approach also avoided the problem of the lack of control groups (a feature of many studies at this time and since) by rejecting all studies that did not include these. Their main criticisms of all the research done up to around 1995 were the small sample sizes, the lack of the use of control groups, the small effect sizes (rarely reported), the short duration of studies, the lack of controls for teacher effects (something found to be particularly common), the lack of details about the environment and the use of inappropriate achievement tests. They also noted that the outcomes that were easier to measure tended to be those things that were assessed, whether these might have been the most meaningful 'effectiveness' metrics or not (Kikpatrick & Cuban, 1998). However, some later single studies successfully investigated more challenging conceptual areas in ways that addressed many of the concerns identified by Kikpatrick and Cuban. One such was Subhi's three-month use of LOGO in Jordan to study the advantages of using ICT to promote the development of creativity and problem solving in gifted children (Subhi, 1999). As with Breese's study referred to above (Breese, 1996), it seems likely that Subhi's subjects may have benefited from affordances within the technology itself - in this case from LOGO's consistent feedback of visual representations of procedures. Subhi noted that the interactive nature of LOGO encouraged social interaction and peer acceptance in the group that was helpful to their individual learning (Subhi, 1999).

Many studies up to around the year 2000 did not however follow the lead of writers such as Breese or Subhi or sufficiently address the concerns identified by Kikpatrick and Cuban. Following their extensive survey of the literature from this period Parr and Fung (2000) concluded that computer assisted learning had until then been shown to be no more effective than other approaches and may in fact have been less effective than other kinds of intervention. Parr and Fung also noted that much that had been written about computers in education had

not really been research or scholarship but comment, reporting of informal observation or opinion, or intuitive speculation. They accepted that the varied and changing nature of computer assisted learning did make rigorous studies in this area difficult but concluded that the main problem for researchers was being able to deal successfully with the complex influences and interactions that arose when ICT is introduced into any learning environment (Parr & Fung, 2000).

Following studies such as those identified above a number of other large-scale studies and overviews of ICT use in schools appeared around 2003 and 2004. One example, based on 178 case studies from 28 countries that looked at the innovative use of ICT in classrooms found that the association between the use of ICT and attainment still remained remarkably unclear (Kozma, 2003). In what may at first seem counter-intuitive, Kozma found, as have others, that frequency of ICT use is not always associated with positive outcomes and that sometimes more use is associated with negative outcomes (Wenglinski, 1998; Kozma, 1994; 2003; Angrist & Lavy, 2002; Pelgrum & Plomp, 2002). Such studies call into doubt earlier claims for a linear positive association between ICT use and educational performance, such as those from the OECD (2001a, 2001b, 2003), which suggested that ICT use always improved pupil's reading interest, motivation and engagement.

However, Kozma noted that in the 178 studies he examined, ICT use was starting to be associated with changes to pedagogy, specifically with a shift to more constructivist approaches as part of programmes aimed at school reform and improvement. He found that less emphasis was reportedly given to factual content and more to collaboration and knowledge creation, with students being encouraged more often to set their own learning goals, plan learning activities and monitor their own progress. Like others writing about the impact or effectiveness of ICT, Kozma concluded that more “studies are needed that directly asses the impact of ICT on student learning, especially those skills such as information handling, problem solving, communication, and collaboration that are considered important for the 21st century” (Kozma, 2003, p. 13). However, the studies that Kozma examined focussed mainly on the use of productivity tools (such as ‘office’ software), although about half examined the use of multimedia and made claims for ICT use that included not only increases in ICT skill but also more positive attitudes to learning and school and enhanced collaborative skills. Fewer than half of these studies therefore reported

increases in the ‘higher order’ study skills, communication skills, information handling or problem solving skills that Kozma identified as being in need of further investigation. A weakness of almost all of the studies surveyed by Kozma, however, is that they were based on the claims of teachers or students and included no independent verification or empirical data (Kozma, 2003).

Suggestions of a bivariate relationship between computer interest or availability and achievement are not uncommon in the literature although many studies tend to report only positive associations between use and benefit. Such evidence about the relationship between computer availability and the educational achievement of students is drawn upon by many commentators. However this can be highly misleading, because computer availability, for example in the home, is also correlated strongly with other characteristics of family background which, when adequately controlled for, reverses many other findings and produces a statistically significant negative correlation (Fuchs & Wössmann, 2004). The quantitative empirical study by Fuchs and Wössmann used data from the Programme for International Student Assessment (PISA) and multivariate regression within which were applied extensive controls for student, family and school background effects and argues that it is how and what computers are used for that makes an educational difference.

For example, students may use computers at home for many things (email, games, web access) but these may often distract them from learning and bivariate results for the availability of computers in schools and pupil achievement are severely biased, according to Fuchs and Wössmann (ibid), because higher levels of computer availability in schools are strongly associated with higher levels of other educational resources. The correlation between student performance and computer availability at school is “small and statistically indistinguishable from zero” when other school characteristics are controlled for (Fuchs and Wössmann, 2004, p. 360). As in the home environment, the amount of computer use in school does not directly correlate with achievement and there may be an optimal amount of computer and internet use significantly above zero but below the level of several times per week:

> “Having a computer at home and using it at school will almost certainly raise some computer skills ... (but) this may come at the expense of other skills ... (which) are the ones that yield significant labour-market returns, not the computer skills” (ibid, p. 375).

Conclusions from this study nonetheless have to be interpreted cautiously because they are not based on randomised controlled experimental evidence but on multivariate, descriptive and conditional correlations and may not necessarily "allow for causal inferences because they may also reflect effects of other, unobservable characteristics" (ibid, p. 361). These results are, however, a substantial improvement upon the bivariate correlations found in many other studies (e.g. Kozma, 1994; 2003) which cannot or do not attempt to disentangle them from other factors.

Rouse, Krueger and Markman's study in 2004 reiterated the earlier concerns of Kikpatrick & Cuban (1998) and also found that most studies reporting strong educational gains were still seriously defective as a result of very small sample sizes, failure to include valid control groups, failure to compare students appropriately and for the failure to control for omitted variables that may have biased outcomes to which Fuchs and Wössmann (2004) had also drawn attention. Rouse, Krueger and Markman's controlled study of 485 elementary school students (i.e. aged around 10-11) was a randomised trial that did not find a large impact for ICT use but only relatively small academic gains for students, much smaller than those claimed by the software vendor. From this study they concluded that disappointing results for ICT use in education may not be due to inadequate research methodology or sample construction as earlier writers might have surmised. Instead they proposed that disappointing results from ICT use may be more likely because “computers may not be an effective substitute for traditional classroom instruction” or because teachers did not know how to make best use of ICT or because particular aspects of schools make it difficult to incorporate ICT into the curriculum (Rouse, Krueger & Markman, 2004, p. 29). Noting that much earlier work investigating whether ICT actually makes an educational difference produced evidence that was quite small and mixed, Rouse et al, were particularly critical of recent studies using functional Magnetic Resonance Imaging (fMRI) of brain activity during interventions with ICT. They found that although ICT use may have been found to affect brain functioning using fMRI such studies failed to explore whether the differences found in brain

activity when using ICT actually translated into measurable changes in relevant educational skills or behaviours (Rouse, Krueger & Markman, 2004).

A different tone to that found in the above studies appears in the report commissioned in 2004 by the British Educational Communications and Technology Agency (Becta) on behalf of DfES to examine the effects of ICT pedagogy on attainment (Cox & Webb, 2004). This drew on over 350 published research documents and a small set of case studies of 26 teachers in 6 primary and 7 secondary schools identified for their advanced and/or integrated use of ICT. This report claimed the existence of widespread evidence that the effective use of ICT made a significant contribution to children's learning, although as Kikpatrick and Cuban had noted, precisely what was meant by 'effective' in such a self-fulfilling statement remained obscure (Kikpatrick & Cuban, 1998). Evidence of improved learning in the DfES study was taken to mean either increased gains in subject tests compared with comparable classes, improvements in class work compared with other classes in the school, or a higher quality of pupil's work compared with previous cohorts. However, the study failed to demonstrate that the effective use of ICT contributes significantly more to pupils' learning than effective traditional teaching. Given that effective traditional teaching appeared to be more common and more easily achievable than the effective use of ICT at the time this report was written, there would seem to have been little incentive for teachers and schools to invest resources in ICT when by doing so they might draw resources away from other learning activities. This was a point also emphasised by Fuchs and Wössmann when they noted that "the introduction of computerized instruction ... (in schools) ... can result in a reallocation of funds in favour of computers, possibly substituting more effective instructional materials" (Fuchs and Wössmann, 2004, p. 363).

In 2004 Ofsted also issued its own series of subject-based reports on the impact of ICT in schools after five years of intensive government activity to promote its use (Ofsted, 2004). These reports included separate overviews of primary and secondary education and subject reports of secondary school level subjects such as art and design, business education, design and technology, English, geography, history, mathematics, modern foreign languages, music, physical education, religious education and science as well as a number of studies of the use of ICT in particular schools. The reports contain claims of considerable success in ICT use for improving educational outcomes but offer few measures

and little evidence to support these. Sometimes Ofsted's careful wording implies causal relationships between the use of ICT and good teaching which on closer examination appear instead to be assumptions that by its nature ICT commonly improves teaching or to be judgments about teachers' skill or confidence in using technology, neither of which are supported by reference to direct evidence. Many of the benefits ascribed to ICTs are accompanied by caveats and qualifiers for claimed associated improvements that include frequent references to 'potential' and the use of phrases such as 'can be', 'might be' or 'when their use is well planned'. Throughout these reports 'effective' use of ICT is clearly meant to mean 'competency in ICT skills', rather than effective in the sense of contributing significantly to academic learning outcomes. In many of these reports considerable store seems to be set by pupils making 'confident use' of ICT or by the use of ICT "to add interest, colour and life" to lessons (Secondary English, p. 5) but this is not often connected to learning benefits that could not just as easily have been attained without the use of ICT, except by implication. Frequently in these reports, and almost without exception in the exemplar case studies presented, it is difficult to see how what is being claimed as a benefit for ICT is not simply a benefit that is gained from good teaching, irrespective of the particular resources used. Amongst the sometimes rather strained claims for the benefits gained from ICT use are found some admissions that "the use of ICT to promote learning and progress ... remains a relatively weak and undeveloped aspect of provision" (Secondary Mathematics, p. 4); that "New Opportunities Fund (NOF) training did not adequately address the identified needs of teachers" (Secondary science, p. 4); or that when using ICT in exemplar case studies that are presented "an example of good achievement" includes core tasks that "could have been equally well done as a card sorting exercise" (Secondary history, p. 6).

When claiming benefits for ICT in this series of eighteen separate reports there are almost no comparisons made with outcomes obtained from alternative (especially traditional) classroom practice. The great majority of claimed improvements do not relate to educational outputs but to ICT competency or to the use of ICT by the teacher as an alternative means of content presentation that could have been facilitated just as easily by more traditional means. Claims made about ICT's contribution to achievement are not accompanied by measures of these or by evidence that achievement is comparable to that from alternative or traditional approaches. More recent Ofsted reports covering ICT

use in schools between 2008-2011 echo these messages from previous years and conclude that “the proportion of secondary schools in the survey in which teaching was judged to be good or outstanding [using ICT] was no better than that in the previous survey” (Ofsted, 2011, p. 4; Ofsted, 2011a).

Attempting to provide such evidence and comparisons, Condie et al (2007) cite a number of intensive reviews of the literature and large scale surveys and summaries of evidence of impact such as those undertaken by Cox et al (2003), Pittard et al (2003) and Harrison et al (2002) which between them reported positive effects on attainment and motivation for some students in some subject areas. However, Condie et al found that the consensus from these and similar studies was that “overall, the evidence on the impact on attainment of learning through ICT remains inconsistent” (Condie et al., 2007, p. 23). Publishing in the same year, Andrews et al (2007) reported a systematic review of the effectiveness of different ICTs in the teaching of written English (composition) for 5-16 year-olds, drawing on evidence from 2,103 papers from between 1998-2003. The focus of this analysis was on the nine most relevant studies and the authors came to the same conclusions as more extensive and earlier reviews of literacy learning by Torgerson & Zhu (2003) and the effect of ICT on literature-related literacies by Locke and Andrews (2004): the effects of ICT are generally neither beneficial nor harmful; that "teachers matter more than technology", that the attitudes, values and practices of teachers strongly mediate 'impact'; and that "there is a mismatch between commercially available multimedia literature software and response-based teaching" (Locke & Andrews, p. 4). Tamim et al's (2012) second-order meta-analysis of the impact of computers and similar technology on learning from over forty years of investigations drew upon 25 different meta-analyses and 1,055 primary studies across a wide range of subject areas and concluded that in general "their direct impact on the goals of schooling has been illusory" (Tamim et al, 2012, p. 5). Tamim et al's study also corroborated earlier conclusions from syntheses of meta-analyses by Hattie (2009) and Schmid et al (2009) in concluding that effect sizes tend to be greater when computer technology is used for supporting cognition (as in the present study) than when it is used simply for presenting content.

Additionally, a consensus from this range of work well captured by Andrews et al was that “we need a new kind of research: one that is at the cutting edge of interface design in the service of learning. Such research will look more like

research and development" (Andrews et al, 2007, p. 334). Research of this kind has begun to emerge in recent years and has made use of digital techonolgy's increasingly rich affordances to create interactive and immersive learning environments that aim to address the objectives identified by Kozma (2003) and Andrews et al (2007) as exemplified in the work of Martin et al (2010) and Thomas (2011).

In contrast to the emphasis found in the early policy rhetoric, there has grown more appreciation of the importance of pedagogy over and above the presence of the technology alone in achieving educational benefit from computers in classrooms. In that sense there is growing understanding that the most important questions about educational technology have never been about the technology at all but about how it is used. There appears to be a growing recognition in published research, if not yet in political policy, that the most effective educational outcomes from computer use are likely to be about identifying its unique affordances for learning and teaching, over, above and/or different from those that already exist in established (non-technology) classroom practice.

Writers have tended increasingly to echo earlier hopes that this growing appreciation will produce more one-to-one interaction (child to screen and child to teacher) that is regarded as freer and less intense, where the teacher can become more of a facilitator and co-researcher of learning and where children take more responsibility for their own learning or, as Jackson put it, can become "self-confident, independent thinkers, whether team players or entrepreneurs, capable of acquiring a range of different skills and adapting to several jobs over a life time" (Jackson 1968, p. 162).

Although some writers conclude that there is now widespread recognition that the educative skills of teachers and not just their technical competences with technology are the determining factor in using ICT to bring about educational improvement (Anderson & Becker, 2001), it seems clear that some teachers use ICT as part of highly traditional approaches to learning, whilst others are more adventurous and that either can be equally effective in terms of student achievement (Cox & Webb, 2004). There is, however, strengthening evidence that "new technology's potential to change the culture of the classroom and the relationship between students and teacher is important, since traditional

classrooms are not ideal learning environments" (Somekh, 2007, p. 98). Despite such evidence there are important caveats, as the earlier evaluation of the Teaching and Learning Technology Programme (TLTP) conducted by Coopers & Lybrand, the Tavistock Institute and the London Institute of Education noted:

> "...existing products need to be embedded into teaching and learning structures for students. This requires the addressing of issues such as cultural change within departments, time for academics to work CBL (computer-based learning) into their teaching curricula, staff development and training and even a fundamental change in the role of teachers in some higher education institutions."
>
> (Coopers and Lybrand et al, 1996, as cited in Somekh, 2007)

A recurrent supposition in much of the writing about the promise of digital technology is that we are now seeing a generation of 'digitally literate' students entering education and that this has profound and inescapable implications for schools, colleges and universities.

Variously labelled the 'Net generation' (Tapscott, 1998), 'Millennials' (Howe & Strauss, 2000, 2003), 'Generation Y', the 'Youtube' or 'Facebook' generation (Shapira, 2008), the 'Backpack generation' (Curtis, 2001), 'Digital natives' (Prensky, 2001) or similar, these young people are presumed to represent a challenge to traditional forms of educational pedagogy and content that differentiates them markedly from earlier generations because of their sophisticated technical skills and learning preferences. Writers espousing these views presume that traditional forms of teaching and learning are therefore no longer appropriate and call for significant changes to the philosophy found within classrooms, although examination of these assumptions and assertions has led some to conclude that much of this debate lacks theoretical or empirical support (Bennett, Maton & Kervin, 2008).

One of the advantages commonly claimed for software and systems designed for these 'digital natives' is that they are learner-centred, that they apply designs where pupils can set their own pace and control their own learning using the 'learner-as-explorer' or student as 'discoverer' model (Scrimshaw, 1997). Such pedagogical approaches are concerned with learner activity and owe much to the theoretical perspectives of phenomenography and constructivism. Phenomenography (Marton, 1981) is derived from studies of student learning and uses the complementary concepts of 'deep' and 'surface' approaches to

learning to discuss how the former involves deep immersion in a task and a focus on gaining insight into structure and intrinsic meaning whilst the latter uses rapid skimming, scanning and browsing to develop subject overview and broad meaning. Both approaches are thought to contribute essential strategies to effective learning. The origins of Constructivism have been traced back to Plato and Socrates (Hawkins, 1994) and both perspectives share the conviction that meaning is created by the learner's activities rather than being imposed or transmitted. Learning is therefore characterised as a way of interacting with and critically evaluating the world, to which the learner brings their individual intentions and motives, their existing knowledge and their established perceptions. The acquisition of information is therefore a necessary, but by itself insufficient, condition for bringing about learning, which requires the further stage of bringing about changes to the individual's established cognition. As a result of learning an individual's conceptions and perceptions of the world become changed.

Several writers have characterised multimedia as having the potential to provide learning environments that exploit the recommendations of these perspectives for a range of different audiences (see for example Squires & McDougall, 1994; Boyle, 1997; McNamara et al., 1998; Crawford, 1999; Vallance et al, 2010; Schaik et al, 2012) because it provides affordances "where control and initiative oscillate between the environment and the individual according to the latter's decisions" (Giardina, 1991, p. 48). However, given the amount of information that such technologies typically present to the user there are concerns that they may as a result become 'surface processors' who 'graze' this 'data storm' to little benefit and may acquire educationally unhelpful habits of "superficial attention, impulsive attention, poor retrieval of relevant ideas, premature closure of thinking and a lack of reflective learning" (ibid, p.52).

In their article looking at multimedia in computer games, Kebritchi and Hirumi focussed on the relationship between such affordances and pedagogy (Kebritchi & Hirumi, 2008). They examined 55 educational games published between 2000-2007 that were developed for strictly educational purposes together with a similar number of published articles on game design from the same period. Few of the latter included discussion of learning theories or instructional strategies and most of the applications grounded their approach in traditional learning theories and instructional practice. They concluded that in only some of the

software available at this time were direct instructional approaches being replaced by learner-centred ones, although they found a few (7) that did encourage questioning and active experimentation (Kebritchi & Hirumi, 2008).

The issues, publications and theoretical models described above have informed the emergence and growth of arguably the two most significant debates about how best we might understand and exploit the relationship between pedagogy, instructional design, subject content and individual learning and are especially relevant for the application of multimedia ICT in learning. These two debates are located within Learning Styles (Kolb, 1984) and Cognitive Load Theory (Sweller et al, 1994) and are each discussed more fully below.

2.6 Learning styles

The reliability, validity and application of instruments designed to report individual learning or cognitive style have been of continuing interest for many years and the use of such instruments remains high on the agenda in discussions about how to improve the attainment of students in schools and elsewhere (Coffield et al., 2004a; Department for Education and Skills, 2004). An interest in learning styles also features strongly in the programmes of institutions charged with the training of current and aspiring school head teachers (e.g., Atkinson, 2003; Munro, 2005). Despite concerns about the validity, reliability and theoretical soundness of such instruments (Coffield et al, 2004b), many mainstream secondary schools and teachers in the UK make use of learning styles and the tools associated with them to inform and guide their pedagogy.

There are a number of reasons why teachers and schools have been attracted to the use of learning styles. In addition to the obvious initial appeal of learning styles for pedagogy, educators and schools have faced rising pressures to reach, sustain or improve upon high levels of student performance in public examinations. So despite well understood reservations about the extent to which any single dimension of learners should be allowed to dictate teaching methods (Grasha, 1984; Loo, 2004), the prospect of being able to identify the most effective way in which each student learns from a limited number of easily understood alternative approaches in order to produce more effective teaching and learning remains an appealing possibility for teachers. Such a possibility appears to address imperatives for increases in performance and for more individualised learning and is also particularly attractive to those who argue that many students are not well served by traditional approaches to teaching, learning and content (Somekh, 2007).

One favoured approach for attaining higher performance levels from students advocates matching teaching methods to each student's learning style. Some argue that there is considerable published work demonstrating that individuals appear to learn best when information is in their 'preferred mode' (Riding & Watts, 1997*)*. However, like many of the studies supporting the use of learning styles, this particular investigation bases its findings on some quite weakly informed choices made by participants - in this case selections made by sixth-

form students from printed learning resources where decisions about which of these to use were based on an “initial brief inspection, as they did not have time to examine the content in detail” (ibid, p.182-3). Beyond this, the study did not examine further the value of the chosen material to the students or its effect on their subsequent learning (Riding & Watts, 1997*)*.

Other studies investigating learning styles, such as that by Ross and Schultz (1999), make similar assumptions to the one above; that most individuals learn best through one or more of the dimensions of the theoretical instrument being used and that ‘matching’ style to instruction produces cognitive and learning benefits (Ross & Schulz, 1999). However the conclusions drawn from Ross and Schultz’s investigation of nursing undergraduates in Calgary are weakened by being based on a very small sample, brief exposure (short period of intervention) and the absence of a control group. Other studies have also found that, in traditional learning environments, matching instructional and pupils’ preferred learning style is a significantly more effective strategy for improving learning than mismatching, especially for younger and less able pupils (Alexander, 1995).

Many who argue for the importance of considering individual differences in learning and teaching with ICT do so on the grounds that such an approach will increase the efficiency of learning. This claim is not helped, however, by the terminology that is used where, as discussed more fully above, ‘efficiency’ is sometimes not well defined and where there is little consistent discrimination between phrases such as ‘learning style’, ‘cognitive style’, ‘cognitive strategy’, ‘learning preference’, ‘learning strategy’ – or between school learning, work-based learning, workplace learning or learning with or without the use of any particular kind of ICT or between outcomes in different subject contexts. In much published work on ICT or multimedia use in learning, such terms are often used in ways which seem to be mutually interchangeable but then on other occasions in ways that imply they are discrete and different. Sometimes writers appear to assume that the terms they use share a common, unambiguous meaning and that any observed effect associated with them can be taken to represent an ‘efficiency’, although outcomes are rarely compared to those observed in the absence of ICT (see Sadler-Smith & Smith, 2004).

Many of these instruments are used in studies where their reliability and validity is unquestioned and where sometimes quite firm conclusions are offered about learning gains or participant performance alongside recommendations for the wider and more frequent use of learning styles and the instrumentation that has been used (e.g. Miller, 2005). Claims for the effectiveness of measures purporting to identify learning styles found in such studies perhaps contribute to the not uncommon assumption in much of the published literature that learning styles are widely and unambiguously understood and that the reliability and validity of instruments for measuring them are unproblematic.

In truth, the research community has not yet settled on any one instrument or set of instruments to measure individual learning preference or style and the theoretical constructs found in many of these instruments have also been heavily criticised; there are serious concerns about many of the instruments in use to the point where the use of some is judged to be unwarranted (Coffield et al, 2004a, 2004b). Additionally, many studies of learning styles do not compare the outcomes from computer-using and non-computer-using groups to explore effect size or acknowledge the implications of the use of small samples for the conclusions reached (e.g. Miller, 2005).

Many tools have been developed to assess the learning preferences of students. There remain many definitions of learning preferences and conflicting findings about the value of matching learning preferences and delivery style. It is difficult to account for these differences and similar findings have been reported with nursing, health and other students, including teachers, children and teenagers. There is debate about whether learning styles are enduring or change with different situations or needs and little is known about the development of learning preferences from child to adulthood. Despite the research done, there is little to indicate the nature and magnitude of change that may be expected in a student's learning from matching or not matching instructional delivery modes to preferred learning style (Cavanagh & Coffin, 1994). Studies attempting to explore learning styles with computer assisted packages have been faced with additional difficulties that may be due to the packages themselves. Several studies from the last twenty years, for example, have concluded that computer assisted learning packages of the period were unsophisticated and limited in their ability to offer users routes through content

that could match their differing needs (Schum, 1990; Alexander, 1995; Atkinson, 2004).

Traditional learning interactions allow the teacher to mediate and optimise learning as an ongoing process but in the computer environments current in the 1990s the learner shouldered most of this responsibility, which often led to them wasting time navigating erratically through complex structures or material (Schum, 1990), most commonly because they were unable to map the original author's structure to their own thinking (Alexander, 1995).

Alexander (ibid) also argues that throughout their academic career, the increasingly verbal content and presentation of academic work to pupils in schools has disadvantaged those whose preference was towards processing information using images. Alexander suggests that computer assisted learning (especially multimedia) has potential to ameliorate this because it can present material that will be more accessible to all learners, but that this has not yet been significantly incorporated into the design of software (Alexander, 1995).

Freedman and Stumpf (1978) identify some of the obvious difficulties of using learning styles in larger classes where individual attention from a teacher trained in the theory and practice of learning styles may be difficult to obtain. This seems likely to be a particular problem in the secondary educational phase in the UK, where teachers now work with a content-driven modular curriculum and usually without the benefit of small classes. Such practical difficulties do not appear to have lessened the appeal of learning styles for teachers but this too should not surprise: the attraction for teachers is that learning styles offer the prospects of greater personalisation of learning for each student and for an approach which is currently at the forefront of interest from policy makers who argue that the benefits of personalised learning are supported by "strong evidence that assessment for learning and intervention strategies for improving students' higher order thinking skills" ... that ... "can make a real impact on GCSE grades. In addition, there is powerful emerging evidence in the area of improving pupil voice and consulting learners about their education" (Department for Education and Skills, 2007).

One of the strongest advocates for learning styles, Kolb (1984), argued that despite the efforts made to assist the learning process in different educational

contexts and subject areas “the weakness of nearly all these … is the failure to recognise and explicitly provide for the differences in learning styles that are characteristic of both individuals and subject matters” (Kolb, 1984, p. 196). He argued that one of the main benefits of addressing this problem would be that teachers would understand better the different ways in which their students learn and therefore be more able to enhance their educational performance.

Kolb introduced one of the most influential and widely used instruments within the field of cognitive style with his Learning Styles Inventory (LSI), developed in 1984 and subsequently revised (LSI-2) in 1985 (Kolb, 1984, 2005). This instrument is based on Kolb's claim that effective learners rely on four different learning styles: *concrete experience*; *reflective observation*; *abstract conceptualisation*; and *active experimentation* (Fig. 2.1) and that learners and teachers can use the LSI to accurately identify the relative importance of each of these stages, understand which they tend to emphasise and thereby improve their knowledge of themselves as learners and teachers.

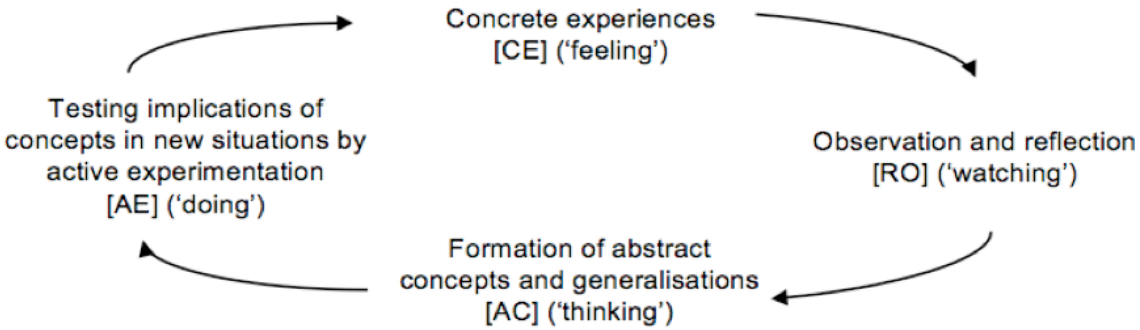


Figure 2.1 Kolb’s iterative stages

For each stage Kolb describes its equivalent learning mode which he argues is characterised by a particular set of *orientations* that are possessed by individuals in that mode (and with its associated learning style) which, although they are influenced by situational factors and the learner's level of maturity, are relatively stable over time and can therefore be used by educators to increase the effectiveness of instruction.

Each individual’s learning style is seen as a combination of these four basic modes and a 12 item self-completion questionnaire is used to determine the

respondent's learning style. Questions follow the same format, with respondents being asked to indicate, for example, whether they "learn by feeling / watching / thinking / doing" and to indicate how strongly each of these alternatives applies to them by ranking the four modes from 1 to 4. Questions are presented the modes in the fixed order of CE, RO, AC and AE (Fig. 2.1) and the questionnaire is scored by summing each of the four 12 item columns this produces. These four summed scores are used to compute values for RO-AE and AC-CE, which are translated into the X and Y co-ordinates (respectively) for a single point on a graph (e.g. see figure 4.1). The data point for an individual on this grid determines which of the four learning styles they possess the most and the distance from the intersect of the X and Y axes its strength. The nearer to the origin an individual's overall data point places them, the more 'balanced' is deemed to be their learning style; the further away they fall from the grid's origin and main axes, the more heavily they rely on the learning style of that quadrant.

Honey and Mumford subsequently developed their own instrument from the work of Kolb (Honey and Mumford, 1992) and share with him the view that learning is strongly influenced by intrinsic preferences which give individuals a persistent liking for certain approaches over others; they also derive four discrete modes or elements from their respective instrument which they argue can be used to define the key characteristics of these individual intrinsic preferences.

The Honey and Mumford Learning Styles Questionnaire (LSQ) contains eighty questions to which each subject is asked to respond with a yes/no choice, depending on whether a given question is felt to be 'like' or 'not like' them. Each of Honey and Mumford's four elements (*Activist*, *Reflector*, *Theorist*, *Pragmatist*) is measured by twenty of these questions, giving each subject a possible maximum score of 20 per element.

Honey and Mumford derive mean scores for the elements *Activist*, *Reflector*, *Theorist* and *Pragmatist* from the data they have built up from the general population, onto which can be mapped the scores of an individual. These mean scores are used to take account of differences between how these elements are scored by the wider population. Honey and Mumford find that the twenty points available for each element tend to be distributed asymmetrically, so if a hypothetical individual gains an equal score for each element this should not be

taken to indicate an equally strong preference. The degree of preference attributed to a given score for each element is calculated by reference to a normal curve distribution plot for the respective element (derived from Honey and Mumford's wider general population sample) and 'moderate' preference is assigned to the central 40% of scores, 'low' and 'strong' to the next 20% respectively, and 'very low' and 'very strong' to the outer 10% regions of the curve. The distribution of scores for each of the four elements is therefore not the same, so their interpretation differs. For example, Fig. 2.2 shows the distribution of scores (from zero to a maximum of 20) across the four elements for the wider population but, because of their lack of symmetry, a score of 11 on each element (highlighted) does not therefore indicate an equal preference. For *Activist* a score of 11 indicates a strong preference; for *Reflector* and *Pragmatist* a low preference; and for *Theorist* it indicates a moderate preference.

Activist	Reflector	Theorist	Pragmatist	
	20	20	20	
		19	19	
	19			
		18	18	Very strong preference
		17	17	
	18			
		16		
12	17	15	16	
	16			Strong preference
11	15	14	15	
10	14	13	14	
9	13	12	13	Moderate preference
8	12	**11**	12	
7				
6	**11**	10	**11**	
5	10	9	10	Low preference
4	9	8	9	
3	8	7	8	
	7	6	7	
2	6	5	6	
	5	4	5	
1	4	3	4	Very low preference
	3	2	3	
0	2	1	2	
	1	0	1	
	0		0	

Figure 2.2 From Honey, P. and Mumford, A. (1992) *The Manual of Learning Styles*, Maidenhead : Peter Honey (p.11).

A comparison of the classification structures used by Kolb and Honey and Mumford shows that despite some small differences of nomenclature, the descriptors used to identify equivalent constructs are very similar and the two instruments map onto each other closely at the theoretical level (Table 2.2).

Table 2.2 Kolb and Honey and Mumford learning style descriptors compared.
[1] Adapted from Honey, P. & Mumford, A. (1992, p.5-7).
[2] Adapted from Kolb, D.A. (1991, p.61-62).

	Honey & Mumford [1]	**Kolb** [2]	
Theorist	Adapts and integrates observations into complex but logically sound theories. Thinks problems through in a vertical, step-by-step logical way and assimilates disparate facts into coherent theories. Tends to be a perfectionist who won't rest until things are tidy and fit into a rational scheme. Likes to analyse and synthesise and is keen on basic assumptions, principles, theories, models and systems thinking – prizes rationality and logic. Tends to ask questions like: 'Does it make sense?', 'How does this fit with that?', 'What are the basic assumptions?'. Tends to be detached, analytical and dedicated to rational objectivity rather than anything subjective or ambiguous. Their approach to problems is consistently logical and they tend to reject anything that does not fit with this. Tries to maximise certainty and feels uncomfortable with subjective judgements, lateral thinking any anything flippant.	Focuses on using logic, ideas and concepts. Emphasises thinking as opposed to feeling and is concerned with building general theories as opposed to understanding intuitively unique, specific areas – a scientific as opposed to an artistic approach to problems. Enjoys and is good at systematic planning, manipulation of abstract symbols and quantitative analysis. Values precision, the rigor and the discipline of analysing ideas and the aesthetic quality of a neat, conceptual system.	*Convergent* Abstract Conceptualisation (AC)
Activist	Involves themselves fully and without bias in new experiences. Enjoys the here and now and is happy to be dominated by immediate experiences. Is open minded and not sceptical and this tends to make them enthusiastic about anything new. Tends to be prepared to try anything once, to act first and consider the consequences afterwards. Their days are filled with activity. They tackle problems by brainstorming. As soon as the excitement from one activity has died down they are busy looking for the next. Tends to thrive on the challenge of new experiences but is bored with implementation and longer term consolidation. Is gregarious and constantly involved with others but in being so seeks to centre all activity around themselves.	Involved in experiences and deals with immediate human situations in a personal way. Emphasises feeling as opposed to thinking and is concerned with the uniqueness and complexity of present reality as opposed to theories and generalisations. Has an intuitive, 'artistic' approach as opposed to the systematic, scientific approach to problems. Enjoys and is good at relating to others. Values relating to people, being involved in real situations and an open-minded approach to life.	*Divergent* Concrete Experience (CE)

Reflector	Likes to stand back to ponder experiences and observe them from many different perspectives. Collects data, both first hand and from others, and prefers to think about it thoroughly before coming to any conclusion. For them the thorough collection and analysis of data about experiences and events is what counts so they tend to postpone reaching definite conclusions for as long as possible. Prefers to take a back seat in meetings and discussions. Enjoys observing other people in action. Listens to others and gets the drift of the discussion before making their own points. Tends to adopt a low profile and has a slightly distant, tolerant, unruffled air about them. When they act it is part of a wide picture which includes the past as well as the present and others' observations as well as their own.	Prefers to understand the meaning of ideas and situations by carefully observing and impartially describing them. Emphasises understanding as opposed to practical application and is concerned with what is true and how things happen as opposed to what is practical – emphasises reflection as opposed to action. Enjoys thinking about the meaning of situations and ideas and is good at seeing their implications. Good at looking at things from different perspectives and at appreciating different points of view. Likes to rely on their own thoughts and feelings to form opinions. Values patience, impartiality, and considered, thoughtful judgment.	*Assimilator* Reflective Observation (RO)
Pragmatist	Is keen on trying out ideas, theories and techniques to see if they work in practice. Positively searches out new ideas and takes the first opportunity to experiment with applications. Likes to get on with things and act quickly and confidently on ideas that attract them. Tends to be impatient with ruminating and open-ended discussions. Is essentially practical and down to earth and likes making practical decisions and solving problems. Tends to respond to problems and opportunities as a kind of 'challenge'. Their approach tends to be 'If it *works* it is good'.	Focuses on actively influencing people and changing situations. Emphasises practical applications as opposed to reflective understanding and has a pragmatic concern with what works as opposed to what is absolute truth. Emphasises doing as opposed to observing. Enjoys as is good at getting things accomplished and is willing to take some risks to achieve their objectives. Values having an impact and influence on the environment around them and likes to see results.	*Accommodator* Active Experimentation (AE)

Honey and Mumford's LSQ has been criticised, however, as an unsatisfactory alternative to Kolb's instrument (Allinson & Hayes, 1990; Duff & Duffy, 2002), although some find it to be a good replacement as it is claimed that the LSQ involves a better conceived learning process model (De Ciantis & Kirton, 1996; Sadler-Smith, 2001). A study of 188 psychology students in the UK was also critical of Kolb's instrument and found low reliability scores and concluded that "the factor structure emerging from a factor analysis bore only a passing resemblance to that predicted by Kolb" (Newstead, 1992, p. 311). The factor structure derived from factor analysis has also been found by others to bear only slight resemblance to the theoretical model for the LSI-2 (Cornwell, Manfredo & Dunlap, 1991; Geiger, Boyle & Pinto, 1992) and the scales to correlate poorly with academic performance (Newstead, 1992). De Ciantis and Kirton's study of 185 managers in the UK and Eire concluded that "no single measure can bear the weight of all of Kolb's constructs" (De Ciantis and Kirton, 1996, p. 809) and that their factor analysis also cast doubt on the configuration of Kolb's theoretical model of two bipolar dimensions. Wiersta and de Jong (2002)

similarly argued that the existence of Kolb's two dimensions, AC-CE and RO-AE, is not well supported by empirical evidence, whilst others have either found alternative dimensional structures or no structures at all (Cornwell, Manfredo and Dunlap, 1991; Geiger, Boyle and Pinto, 1992). Other studies have reached similar conclusions for the LSQ (Tepper et al., 1993; Duff & Duffy, 2002). The general consensus of such studies is that Kolb "attempted to contain within a single measure three unrelated aspects of cognition: style, level, and process" (De Ciantis & Kirton, 1996). It has been concluded that such studies "constitute a serious challenge to the construct validity of the LSI" (Coffield et al., 2004a, 2004b).

Criticism of Kolb's LSI has also been made from a psychometric and theoretical point of view with regard to the scale scoring, in particular regarding the 'ipsativity' of the instrument and the way in which its scoring rates each learning mode not in any absolute sense but only in comparison to three other learning modes (Loo, 1999; Wierstra and de Jong, 2002). This introduces many measurement problems such as difficulty in meaningfully summing ranks across items - because a high score on one dimension forces correspondingly low scores on others. When comparing scores between subjects this forces negative correlations between these high and low scores, which leads to lower estimates of reliability, causes misleading factor patterns, and limits interpretability (Loo, 1999; Wierstra & de Jong, 2002; Henson & Hwang, 2002).

However, Kolb has defended the LSI by arguing that the way his instrument invites respondents to compare learning modes gives it 'ecological validity' – that is, that it imitates the reality in which a learner makes choices between different ways of learning and, additionally, lessens the influence of the respondent's acquiescence to the norm of socially desirable responses because the choices offered are all of equal social desirability (Kolb, 1981; Smith and Kolb, 1986a, 1986b). Kolb has also argued that it is only the four scale scores that are ipsative, whilst the AC-CE and AE-RO scores are not – therefore the instrument as a whole does not exhibit ipsative features (Mainemelis, Boyatzis & Kolb, 2002), whilst others point out that the value of ipsative measures might in any event outweigh their limitations when a significant response bias exists (Hicks, 1970). Despite these largely unresolved issues of data interpretation, researchers tend to concur that factor analysis remains a useful and appropriate

method for examining the internal validity of the LSI, providing the limitations of the ipsative data are taken into account.

As well as concerns over the ipsative nature of the LSI, there have been reservations expressed about the likely effects of 'positional response'. This regularity in the LSI has been identified as a source of concern by a number of writers (Atkinson, 1988; Veres, et al, 1987, 1991; Cornwell, Manfredo & Dunlap, 1991; Wierstra and de Jong, 2002). Such concerns arise because of the fixed position of the learning behaviours in the instrument when presented to respondents – usually items are arranged in order as CE, RO, AC and AE. Even when respondents may not become aware of any content similarity within this structure, the concern is that they may be influenced by the systematic placing of the alternatives and a 'positional response set' may therefore be presented within the scoring. Attempts to eliminate this inbuilt probable response bias by the random presentation of the sentence endings "increased dramatically" the test-retest reliabilities (Veres, Sims & Locklear, 1991, p. 149).

The LSI-2 has attracted both supporters and critics alike and different studies have variously argued both for and against its validity in different contexts. For example, a study by Katz (1986) which used a Hebrew version of the LSI with 739 Israeli students offered empirical support for the instrument's construct validity and claimed that the findings allowed the theory to be "generalised to another culture and population" (ibid, p. 1326), although similar work in Hong Kong by Lam with 95 workers (Lam, 1997) and by others with HE students (Fung, Ho & Kwan, 1993; Klein et al., 2007) concluded that the LSI lacked reasonable stability and internal validity when measuring the learning styles of non-western samples.

Reservations have also been expressed about whether an individual's classification by the LSI was more likely to be due largely to "personal characteristics, situational factors or measurement error" than to any measure directly associated particularly with learning (Stumpf & Freedman, 1981, p. 297). After reviewing findings from literature in the field, others have also concluded that what is measured by the LSI and the LSQ is not a discrete feature of a respondent's approach to learning at all, but is instead more accurately a reflection of personality (Caple & Martin, 1994; Jackson & Lawty-Jones, 1996; Furnham, Jackson & Miller, 1999; Duff & Duffy, 2002).

Although its structure renders the LSQ less problematic regarding the likelihood of it producing a positional response or ipsativity, factor studies have not been supportive of the four factor structure and have found the LSQ unable to discriminate between the theoretical styles it purports to measure (Fung, Ho & Kwan, 1993; Swailes & Senior, 1999). Others have found the LSQ to have poor reliability, to be unable to attain performance "generally accepted as a minimum for psychometric instruments" and to have little promise as a predictive instrument (Zwanenberg & Wilkinson, 2000, p. 379).

The relationship between teaching methods and learning styles may also be much less clear and direct than authors of the LSI and LSQ might wish (Garner, 2000). In a study using 138 UK management students, learning modes were matched with learning style as measured by Kolb's LSI-2 but the educational outcomes were found to be inconclusive and not consistent with the instrument's basic hypothesis (Allinson & Hayes, 1990). In another study the LSI-2 was used to assign 154 US nursing students to one of three groups: one of which featured teaching which was designed to be consistent with their learning style; another which was not and a third control group. No significant differences in achievement between the three groups were found and therefore no evidence to support the hypothesis that teaching which is consistent with an individual's learning style is likely to improve their learning (McNeal and Dwyer, 1999). The studies matching teaching methods to these learning styles have been inconclusive and inconsistent with the instrument's basic hypothesis (Allinson & Hayes, 1990; Garner, 2000), and the matching has not led to increases in achievement (McNeal & Dwyer, 1999). The ineffectiveness of such matching may be attributable to what Argyris described as the difference between *espoused theory* and *theory in use* (Argyris, 1976) – that is, the difference to be found between what individuals say they do and what they actually do. Learners may identify a particular approach to learning as the one they most frequently use but unless this is experimentally verified we are unable to determine the accuracy of such reports and a learner may well employ entirely different strategies in practice to those they consistently report in good faith on questionnaires or during interview. This problematic limitation of instruments employing self-reporting (see Veenman, Prins and Verheij, 2003) has featured in other studies and has led some to conclude that as a result of this and other

concerns the LSQ is “invalid and unreliable as a measure of preference for instruction and as a predictor of academic performance” (Price, 2004, p. 695).

However, serious reservations about the value of learning style metrics have persisted (Coffield, 2004a) and so perhaps unsurprisingly, for every study of the LSI and the LSQ which offers support to some degree there appear to be many others which express serious reservations about their validity, theoretical soundness or effectiveness for improving learning (Smith, Sekar & Townsend, 2002). Critics of the LSI in particular maintain that its psychometric properties have not been adequately assessed and therefore its use for education research purposes is premature. Some critics of the LSQ have gone so far as to conclude that it is “both invalid and unreliable as a measure of preference for instruction and as a predictor of academic performance” (Price, 2004, p. 695).

These criticisms have not stopped the bandwagon effect of advocating learning styles for use by teachers to better enhance students’ learning, or their continued use in many schools. It is notable that a systematic comparison of 71 different models of learning styles concluded that whilst the LSI-2 and LSQ had been found by some to possess reasonable test-retest reliability, both lacked construct and predictive validity, there is insufficient evidence of internal consistency, and that despite revision these scales “should not be used as the theoretical justification for changing practice” (Coffield et al, 2004b, p. 139). This too has not stopped many teachers using these scales and basing teaching and learning decisions on the consequential results from these tests.

The present study was designed to explore whether, therefore, given the close conceptual equivalence of the LSI-2 and the LSQ, they produce comparable outputs for a sample of secondary (K11-K13) students in the UK and whether there is empirical evidence for the four learning styles. Additionally this study sought to discover whether these instruments produce worthwhile information for teachers and how teachers faced with the research evidence concerning the value of these instruments would respond. Should these two instruments prove valid and reliable it was felt that it could be worthwhile to include them in the present study when evaluating the influence of individual preference on learning outcomes from the use of multimedia software, particularly given my earlier observations of what appeared to be a relationship between the use of *Zork!* and individual learner abilities (see Chapter 1). An important question, therefore,

is about whether the instruments developed by Kolb and Honey and Mumford for the measuring of learning styles offer benefits for improving individualised instruction in the context of English literature and what are the implications for the use of multimedia? This question therefore became the focus of the field study reported in Chapter 4.

2.7 Cognitive Load Theory

The use of multimedia is argued to have the potential to significantly improve instructional efficacy, particularly with regard to the successful learning of information and the development of understanding (Mayer, 2008; Miller et al., 2011) but concerns persist about the degree to which its design and use have realised or optimised such potential (Argyris,1976; Sweller & Chandler, 1994; Tabbers et al., 2000; Massa & Mayer, 2006; Schnotz & Kürschner, 2007). The application of Cognitive Load Theory (Sweller et al., 1998) has been at the forefront of much experimental work in this area and has important implications for optimising the design of educational multimedia (Mayer & Moreno, 2002; Mayer, 2003, 2009). However, some writers express concern that the theory has developed little since its proposition in 1998 (Moreno, 2010) whilst others note that despite its great influence on educational research in recent years Cognitive Load Theory is by its formulation difficult to disprove; a difficulty compounded by the lack of a means by which cognitive load may be measured directly (De Jong, 2010).

Cognitive Load Theory (CLT) seeks to explain why some material is more difficult to learn than other material. It is based on the proposition that the human brain uses two types of memory: short-term and long-term memory, where short-term memory is seen as having limited storage capacity and long-term memory is seen as having almost unlimited storage capacity (Sweller, 1994). CLT proposes that the existence of these two types of memory in humans is important because it determines and has been determined by the way we learn. Using short term memory, we develop *schema* (e.g. cognitive constructs, organised knowledge, or classifications of problems into categories: 'cognitive constructs that incorporate multiple elements of information into a single element with a specific function' (Paas et al., 2003, p. 2) and store these in long-term memory. Schema help us with tasks such as solving problems that we have not seen before by using our learning about similar kinds of problems

we have solved in the past. With practice, using our schema can speed up problem solving and task execution by partially automating our cognitive activity when responding to situations or problems that are similar to ones we have learned about in the past. We use the limited capacity of short-term memory to manipulate existing schema (or to create new ones) and apply these to the solution of problems which would otherwise prove too complex for us to deal with if we always had to begin from first principles.

CLT argues that whether some material is easier to learn than other material depends in large part on the degree to which we are able to reduce the amount of processing (cognitive load) needed to solve a problem or learn something new by using schema acquisition and automation: "schemas effectively increase the amount of information that can be held in working memory by chunking individual elements into a single element" (Sweller, 1994, p. 299). 'Chunking' is thought to be a common feature of the way short term memory operates to organise information when constructing schema (Chase & Simon, 1973). Neuroscience speculates that cognitive load may be directly linked to physical 'memory load' as a result of the way the brain coordinates the firing of neurons, but this phenomenon is not well understood as yet and alternative mechanisms have also been proposed to explain how chunking may be handled in working memory (O'Reilly et al., 2003).

CLT identifies a number of key factors which, independently, can increase the cognitive load on a learner (or can produce unhelpful types of cognitive load), when dealing with inherently complex material or when confronted by poor instructional design. Given the arguments that learning with multimedia can be more efficient and effective, a consideration of both of these latter factors is important.

In contemporary CLT, three expressions of cognitive load are understood to operate. *Extraneous cognitive load* is the difficulty, or load on the learner's working memory, associated with the design of instructional materials and the way these present information to the learner. High extraneous cognitive load is harmful to learning and is created as a result of unnecessary processing caused by the instructional design. *Germane cognitive load* is the load that is directed towards constructing, processing and automating schemas. It can also be manipulated by the instructional design but is helpful to learning because it

results from features of the design which direct attention towards relevant learning processes. *Intrinsic cognitive load* is directly attributable to the inherent complexity or difficulty of the material to be learned and may not be changed by the teacher. It is assumed to be unaffected by the instructional design and to be the product of a combination of the learner's prior knowledge and the intrinsic complexity of the learning material (Sweller & Chandler, 1994).

Researchers in the field of CLT attempt to arrange the instructional control of cognitive load so as to optimize the load experienced by subjects in learning situations. The distinction between optimising, as opposed to maximising or minimizing, is important and is commonly misunderstood. The aim of cognitive load researchers is not simply to reduce the overall cognitive load on learners, as is sometimes incorrectly assumed, but to avoid extreme situations where there is too little load or too much load, because learning deteriorates in both situations (Young & Stanton, 2002). Cognitive load researchers wish to produce both the optimum amount of load for learning and to promote load *of the right kind*; that is, they seek to optimise the load that contributes to learning (i.e. germane load) and reduce the load imposed by elements that hamper learning (i.e. extraneous load).

When learners find instructional tasks easy (for example, when intrinsic load is low), any extraneous cognitive load imposed by the learning resources or context may have little or no significant negative effect on learning. This is not the case when tasks are more difficult and the intrinsic cognitive load is high; under these circumstances it is important to take account of (and if possible reduce) the extraneous load on learners (Van Merriënboer & Sweller, 2005).

However, in some learning situations it may be difficult to reduce the intrinsic load on learners because the learning tasks may be very complex, they may have unavoidably high element interactivity or may require the development and application of many different schema, such as in situations where multiple choices are available to the learner regarding the information to be selected and applied. This would be the case in the example given below concerning English literature, where evidence and judgement about the personality and interactions of a dramatic character are being selected and combined.

Research using CLT has sought to find ways to manage high intrinsic cognitive load (Pollock et al., 2002) by approaches that take account of learner's prior knowledge (see Kalyuga et al., 2003) or that allow for the level of germane load imposed on learners by different instructional materials (Salomon, 1984; Kalyuga et al., 1998; Cierniak et al., 2009).

When considering the design of resources that teachers may use to promote learning, CLT argues that the physical integration of multiple sources of information is generally beneficial for learners. Physical integration happens when, for example, text and images are combined in multimedia applications or on the page of a textbook so that each does not simply replicate the content contained in the other. Physical integration eliminates the need for learners to split their attention between (for example) physically separate illustrations and text on a page or screen when learning material. Where physical integration has not happened, the learner's attention is divided unhelpfully between the separate elements, as they attempt to process each one individually and make cognitive associations between them. This *split-attention effect* is regarded as unhelpful for learning because it increases extraneous load and so learning materials featuring split-attention may overwhelm working memory capacity (Chandler & Sweller, 1992; Sweller, 1994; Eilam & Poyas, 2008).

However, subsequent studies have found that in any given subject domain, certain learning resources which are beneficial for less expert learners become disadvantageous as learners become more expert (Kalyuga et al., 1998). In particular, the physical integration of information as a means to minimise the split-attention effect becomes less helpful to learners as their expertise grows and it becomes counter-productive for learning as expertise increases still further (Kalyuga et al, 1998).

For more expert learners, the physical separation of information can be more advantageous than its integration, because they are likely to already possess the schema that the learning resources are attempting to promote in less experienced learners. As a result, learning resources may become subject, therefore, to an *expertise-reversal effect* (Schnotz, 2010). The expertise-reversal effect appears when more expert learners find it easier to handle complex instructional material but more difficult to learn from material that is designed to integrate separate elements in order to aid less experienced learners to

construct appropriate mental representations (schema); in such cases experienced learners are confronted with instructional guidance that is redundant for them, and this can be difficult to ignore, thus increasing cognitive load and reducing the efficiency of their learning (Kalyuga et al., 2003). Intrinsic cognitive load can therefore be determined only in the light of reference to a particular level of expertise (Schnotz &Kürschner, 2007).

Obtaining measures of individual cognitive load from learners can be problematic, not least because learners, faced with a new topic or domain, may find it hard to know whether any difficulty they experience is due more to the content or to the instructional design. In such circumstances it can be difficult or impossible to identify reliably and disentangle the origins of extraneous and intrinsic cognitive load (Cierniak et al., 2009). As a result of either one or the other being higher or lower for different learners, the *overall* cognitive load for different learners may be equally high. However, being able to take due account of the intrinsic load of learning tasks when using instructional multimedia is of importance for educators who are interested in managing such resources to obtain the greatest learning gains for individuals.

Because intrinsic load varies not just as a result of the inherent complexity of the learning material but also with the expertise of the individual learner in that subject or content area, establishing the intrinsic load for individual learners is important for maximising their learning. However the measurement and management of intrinsic cognitive load can be problematical, not least because objective measures are difficult to obtain and subjective measures, whilst easier to obtain, are not without their own difficulties.

One of the main problems with subjective (i.e. self-report) instruments in general is attributable to what Argyris described as the difference between *espoused theory* and *theory in use* (Argyris, 1976), that is, the difference to be found between what individuals say they do and what they actually do. Learners may identify a particular approach to, or difficulty with, learning as the one they most frequently use or experience, but unless this is verified experimentally or by other means we are unable to determine the accuracy of such reports, and a learner may well employ entirely different strategies (or experience entirely different difficulties) in practice from those they consistently report in good faith on questionnaires or during interview. This problematic limitation of instruments

employing self-reporting (see Veenman, Prins and Verheij, 2003) has also been identified with regard to the use of instruments proposed for measuring cognitive load. This becomes particularly problematic when cognitive load varies as a result of the learner's changing framework of reference and increased schema acquisition in response to the course of learning (i.e. as learner expertise increases), because the difficulties that are perceived by the learner and the associated degree of helpfulness of particular resources may be continuously changing as learning proceeds (Schnotz and Kürschner, 2007). However, work comparing different approaches for establishing item difficulty levels has shown that individual learners perform well when judging the difficulty level of items and are likely to be more accurate than subject experts at establishing the 'true' level of difficulty – that is, the level established from a large sample size (Wauters et al, 2012).

The present study draws on previous work in which differences in expertise were found to give the largest and most reliable explanation for differences in performance between individuals. Whilst acknowledging the difficulties of measuring cognitive load outlined by De Jong (2010), this study also took account of Kalyuga et al. (1998) and Wauters et al. (2012), who found that subjective ratings of mental effort, i.e. the mental effort associated with learning the instructional materials, was an effective and accurate proxy measure of cognitive load. The present study follows Kalyuga and adopts the use of subjective ratings of mental effort with exemplar learning materials as an ecologically valid and reliable proxy for prior learning (and therefore for a main element of intrinsic cognitive load) when comparing the learning gains of groups which were using either existing or alternative (multimedia-based) approaches to learning, allowing for different levels of cognitive load attributable to the instructional materials.

Research on multimedia and learning has demonstrated learning improvements in areas such as science (Zheng et al., 2008); management (Passerini, 2007); chemistry (Lee, 2007; Su, 2008); physical education (Vernadakis et al., 2006); audio engineering (Cochrane, 2007); history (Williams, 2009); and physics (Stelzer et al., 2009). Throughout these run a number of threads that are relevant to the present study, for example with regard to the use of different human-computer interface elements. In one study in which subjects used multimedia 'books' the design of the interface was deliberately varied and some

elements were found to draw girls to interact with multimedia whilst different ones exhibited a stronger draw on boys (Passig & Levin, 2001). From this the authors concluded that the way material in multimedia software is presented to the learner and the nature of the interaction between these two affects the child's will to use it, as well as the design of the screen and the management of the message. Such findings are both intriguing and puzzling - as with the above article by Passig and Levin - they often use sample sizes too small to permit generalisation but at the same time hint at possibly significant implications for multimedia design.

Many recent contributors to the field of multimedia use rest much of their work upon the theoretical foundations of CLT (e.g. Mayer, 1997, 2001; Moreno & Mayer 1999, 2000). Within such work Mayer (2001) in particular has developed several influential theoretical concepts. The first of these is the *modality principle* which comprises two strands, temporal and spatial. The modality principle proposes that in environments involving words and images - and including multimedia environments is particular - words should be spoken not presented as text so that they access the auditory channel of human cognition, so they do not interfere with processing the pictorial information. The second principle - the *temporal contiguity principle* - argues that better learning results when spoken and pictorial information is presented together, not sequentially. The third principle - the *spatial contiguity principle* - argues that better learning results when text and pictures are physically integrated.

Given this, one might imagine that animated pedagogical agents such as those commonly seen in multimedia software might not enhance the learning effectiveness of such environments, because their presence on-screen next to pictures, animations or diagrams could, according to the *modality principle* and the *spatial contiguity principle*, lead to a splitting of learner attention (Craig, Gholson & Driscoll, 2002). Similarly, one might reasonably assume that multimedia software for learning would function best when it presents spoken and pictorial information together so as not to violate the *temporal contiguity* principle.

How to make best educational use of software - including applications using multimedia - is still unclear, despite much research over the last 20 years. Most commercially produced educational software is poorly evaluated, or not

evaluated at all, and often not designed according to any instructional principals or theory. This is important because such software usually allows for less teacher mediation than other educational resources and teachers are generally not experienced or skilled at selecting, adapting and using such software as a tool for enquiry, problem solving and collaboration or in making it integral to learning. In 2004 Williams, Boone and Kingsley (2004) cited Garner's earlier work (Garner, 2000) to argue in their study that designers should therefore bear in mind the different learning styles of children and that whilst some research had shown the positive effect of ICT in some settings there was still a lack of supporting evidence for much of the application of ICT that was seen schools. Within this they pointed out that software developers rarely followed a formal instructional development procedure regarding instructional design, despite the overwhelming majority of their participants placing instructional design as the first priority, followed by curriculum relevance, then training and supplementary materials, then cost, and lastly the ability to customise the software. They concluded that most teachers felt that developers needed to work more closely with teachers and students (Williams, Boone & Kingsley, 2004). This principle has been applied in the design of the multimedia software used in the present study, which was created after years of experience in working with other teachers in different kinds of classroom in schools.

One weakness of the Williams, Boone and Kingsley (2004) study's findings is that it was a survey of teacher opinion within only one school district in the USA. In contrast, an experimental study by Erhel and Jamet (2006) featured careful statistical analysis of empirical data from a pre- and post-test intervention using a multimedia package that used explanatory pictures showing the functioning of the heart and the replication of the AIDS virus. Previous studies have shown that learning with illustrated documents significantly improves memorisation (Levie & Lentz, 1982) and the software used by Erhel and Jamet applied this finding to include various modalities such as text below the picture, text integrated within the picture and text integrated within the picture with pop-up windows. Their study used 72 university psychology students (11 male, 61 females) aged 18-25 yrs. old. Pre-post test on heart function and AIDS were followed by 10 minutes exposure to material in three groups: a 'pop-up' group, a 'separate text and information' group; and an 'integrated text and illustration' group. Post-test questions measured text memorization; whether students could draw complex inferences from what they had learned and apply their

knowledge; whether they could recall the referential links between text and diagram; and the memorization of illustrated elements.

Erhel and Jamet conclude that their results clearly demonstrate that “learners who had been exposed to the condition with the descriptive and explanatory texts accompanied by an explanatory illustration obtained better conceptual recall and problem-solving performances than their counterparts who had been exposed to the unillustrated condition” (Erhel & Jamet, 2006, p.138). Other studies by Glenberg & Langston (1992), Gyselnick & Tardieu (1999), and Gyselinck et al, (2000) have corroborated these findings in similar studies.

The principle here is that if text and illustration are spatially separated, learners have to move many times between the two to reconstruct the cognitive links between the two so as to understand the ideas being conveyed. The argument is that this switching (the *split attention effect* of Chandler & Sweller, 1991, 1992, 1996; and Sweller, 1999) degrades learning by dividing attention between two sources of information. The proposal therefore is that if we improve the spatial integration of information (i.e. we apply Mayer's *spatial contiguity* effect) this should improve the mental model that is constructed by the learner and produce an improvement in learner performance (recall, test answers of factual knowledge, etc.) in both paper based and multimedia formats.

In applying this proposal Erhel and Jamet’s study (2006) applied the spatial contiguity and temporal contiguity principles through the use of ‘pop up widows’ or ‘pop-ups’ as they are often known. Pop-up windows are small pages of information that appear on-screen in front of the existing display in response to particular user activity – such as clicking or ‘hovering’ the computer mouse, pointer or finger (if using a touch-sensitive screen) over a specific area of the display. Erhel and Jamet found that pop-up windows were particularly useful because they allowed the multimedia software to thin down the density of information permanently presented on screen and encouraged more active user engagement with the material. However, in an earlier study Betrancourt & Bisseret (1998) found that whilst pop-up windows produced faster and more efficient learning with better transfer and memorization, they also concluded that pop-up windows conferred no benefit over more straightforward uses of integrated text/image formats, so the reduction of perceptual load and increased

integration of information they produced did not appear to help the learning process.

Erhel and Jamet's (2006) study found that groups using software that made use of pop-up windows did significantly better than those using software that instead featured 'separated' information and noted that many works in field of cognitive load ascribe similar results to the disappearance of the split attention effect. Erhel and Jamet disagree and instead propose that the significant differences they found between the groups with reference to better memorization of elements from the groups using software with pop-up windows may be attributable to a perceptual overload produced by the integrated material used by the other groups as a result of its higher on-screen information density. They suggest that it may therefore be important to consider information density in tandem with the split-attention effect when designing educational multimedia software. However, other studies have found it to be likely that too much emphasis has been placed on the importance of spatial proximity when explaining the appearance and effect of the split-attention effect and that a range of different formats of instructional texts and pictures may facilitate learning just as effectively as integrated formats. This may be important in circumstances where such integration is difficult, as when texts are extensive in length, for example and where pop-up windows or segmenting text and including labelling in pictures may present an equally effective design principle for facilitating optimum cognitive load, as in the present study (Betrancourt & Bisseret, 1998; Erhel & Jamet, 2006; Florax & Ploetzner, 2010).

Jamet also later found that sequential presentations produced superior scores for learning and scores were further enhanced by colour changes that provoked attention guiding in participants. The limitations of this study was its use of learners naïve to the topic (which may explain lower transfer) and some similarity of colour cues in the system-paced multimedia which between them may have reduced the effects of attention guiding when a self-paced system is used (Jamet et al, 2008). However both guiding attention and reducing unnecessary visual search processes - for example by the use of spatial proximity or sequential arrangement of learning material - may be helpful for learning and it has been proposed that this mechanism operates with particular efficiency in contexts where visual search requirements in the learning material are potentially high (Ozcelik et al, 2010).

The degree of learner control is also a significant factor that may influence the appearance of perceptual and cognitive overload. Some studies found that participants learned more efficiently without the pictures (because processing the pictures needed more time but did not benefit the learning process), so there was no multimedia affect (cf. Mayer, 2001), but as the learners did not perform any worse, there was no redundancy effect either (cf Sweller, 1999, 2005a) (Rasch & Schnotz, 2009). Interestingly, this was a self-paced experiment and the writers propose that this may have been relevant, because participants who were not presented with pictures may have had to read the text more carefully in order to understand the subject matter, whereas those using pictures may have been able to process the text at a more superficial level, but each group would achieve the same outcomes. Similarly, the reduced learning efficiency of participants processing pictures which were simply illustrating what they already had in their mind was not harmful for learning because any such effect may have been offset by longer learning times. As learning time was not constrained in this study it was not possible to test this proposal empirically.

However, the Rasch and Schnotz study did not control for prior learning (unlike the present study) and its authors also do not speculate about the possibility that the context may have rendered the use of text with and without pictures for their different groups less important, as participants may have perceived the subject matter to be of low complexity and intrinsic difficulty (university students studying different daytimes and days on the earth) and this would have imposed a relatively small cognitive load on subjects. This again is different to the present study where the context of English Literature texts for GCSE examination study provides high-complexity content in contrast to conditions of low overall cognitive load, where multimedia and redundancy effects are less likely to appear (Mayer, 2001; Sweller, 1999b, 2005; Rasch & Schnotz, 2009).

Schmidt-Weigand et al, (2010) found that when given control of time themselves, learners spend more time looking at text but when given less time (or when they use system-paced applications offering only short times for study) they attend more to pictures instead. Participant viewing behaviour in such circumstances has been found to be text-directed in nature, but this may be largely due to subjects' greater familiarity with text as a learning medium. Schmidt-Weigand et al, propose that more complex visual information such as

statistical graphs may provoke longer inspection times (i.e. a learning-material-complexity effect). Reading strategies may also become more influential as the text becomes longer and learners need to spend more time attending to it and Tabbers (2002) found a reverse-modality effect when the average time on task was above 20 mins.

For learning material featuring longer texts, it may therefore be best to present text and pictures sequentially to ensure that learners pay equal attention to both formats and sufficiently process the visual material. Alternatively, learners could be given control of the instructional pace, making the trade-off between text and image processing unnecessary; and this was the principle applied in the multimedia software used in the present study. It appears that any benefits of using written over spoken multimedia presentation (or vice versa) disappear under situations where learner control is high and although much research suggests that the modality effect appears under certain conditions, it is not likely to be always due to the same underlying cognitive mechanisms (Schüler et al, 2012)

Similarly Bodemer & Faust (2006) found that the use of use of drag-and-drop elements improved learning when these allowed for the active reconstruction of a document and concluded that more interaction leads to better learning. Like Erhel and Jamet (2006), they suggested that the use of pop-ups in a multimedia environment might also have similarly helped develop a higher quality mental representation. In all these studies, it is difficult to tell apart an effect that might be due to the removal of perceptual overload from one that might equally be due to environmental interactivity. For example the use of images featuring exaggeration, humour, symbols and other cartoon-elements has been found to stimulate the more active involvement of students and proved more useful in teaching abstract concepts and improving recall of knowledge than more traditional and formal approaches (Dalacosta et al, 2009).

Park et al., (2011) used 100 high school students to explore the effect of introducing ‘seductive details’ into a multimedia tool for learning about biology. Seductive details are interesting but irrelevant information that appears with text which reduces the recall or learning of relevant and ‘non-seductive’ text ideas (Garner et al,1989). Seductive details are generally therefore regarded as interesting material that provides additional information but which is not

essential for accomplishing the learning objectives of the instructional task concerned and which generally impedes learning (Lehman et al, 2007). However Park demonstrated that the presence of seductive details under low cognitive load conditions (e.g. as used in the graphic user interface in the software used in present study) produced greater learning performance than when these details were absent, suggesting that non-redundant and interesting but irrelevant learning material can be beneficial for learning but only under certain conditions. Contrary to CLT, the group experiencing the presence of seductive details did not experience any higher cognitive load than the group that learned with on-screen text and no seductive details, but this was thought to be due to the groups' non-novice status as learners of the instructional material (Park et al., 2011). Motivation is also an important moderator of cognitive load and should not be underestimated, as the motivational or arousing role of seductive details may not be insignificant for learning. Increasing cognitive engagement via affective and motivational factors is known to mediate learning by increasing (or decreasing) the amount of cognitive resources that students apply to their learning, as is argued, for example by the Cognitive Affect Theory of Learning with Media (Moreno, 2005, 2006, 2007, 2009).

2.8 Conclusion

Being in the midst of change makes it difficult for us to properly understand it. One the one hand we wish to beware of promoting new communications media uncritically, but on the other we do not wish to produce young people uninformed about its social and cultural implications or deprive them of innovative opportunities for learning that it may offer (Kenway, 1996).

Whilst ICT can be seen as the ideal postmodern technology for a 'Net Generation' in an increasingly globalised world, this should not be taken to mean that the main aim of schools is to prepare pupils for economic success, as that may risk leading us into an overly prescriptive, narrow and skills-focussed curriculum with attendant standardised content and a culture dominated by accountability in schools, as some fear may already be close (Conlon, 2000). However, an education system that only produces liberally educated but unemployable young people seems equally unattractive. The difficulty is to balance these vocational and developmental functions of education so as to

avoid an uncritical emphasis on ‘computer literacy ideology’ whilst appropriately valuing the social function of schooling.

The reason that clear conclusions have not been drawn from research which might have helped with navigating a way through this difficulty is because the desired outcomes of using ICT in schools remain confused between three different sets of aspirations: developing students’ computer literacy; producing better learning (developing higher order thinking skills, basic skills and more content acquisition); and enabling more student-centred learning. Using computers has been shown to improve standardised test scores, but much research that concludes this is considered to be methodologically flawed and in addition frequent hardware and software changes compromise analysis over time and conspire to make earlier studies virtually obsolete (Kikpatrick & Cuban, 1998).

Using ICT beyond simple skills-based instruction means that teachers become critical elements in the process of learning and policy makers therefore find themselves “facing the familiar conundrum in the history of school reform: teachers as both the problem and the solution.” (ibid, :8). Given all the other factors that affect whether and how ICT will or will not be used in schools - and to what effect - what seems imperative is that educators have a clear sense of their goals for ICT and that researchers focus accordingly (Kikpatrick & Cuban, 1998).

Against the above background of published work the present study turns its attention to the little-explored area of multimedia use in learning and teaching in English Literature within the UK secondary school curriculum.

Teacher training in the 1970s and 1980s emphasised the importance of relating learning to individual needs and to individualising the curriculum. Exploration, play and collaborative learning were seen as being the most effective ways in which such approaches could be operationalized to achieve individual development. The potential of ICT to enable these kinds of student-centred learning seemed evident to me from my early experiences with software such as *Zork!*. I was particular taken by the way this software appeared to promote deep individual learning through exploration and play whilst at the same time

encouraging shared and collaborative learning amongst pupils who then seemed comfortable in taking more control of their own learning.

The introduction of ICT into schools during the 1980s and its adoption into the National Curriculum was accompanied by high expectations of the impact it would have on subject based learning. In these early days the UK government approach to ICT adoption was, perhaps understandably, heavily focused on the provision of equipment and infrastructure and to some degree teacher training.

There was criticism of this approach to ICT adoption, particularly of what was seen as an over-emphasis on hardware at the expense of training or software, a lack of evaluation and a tendency to ignore research strongly suggesting that expectations were being raised to unrealistic levels (Somekh, 2000). Many of the government initiatives from the 1980s for ICT were also criticised on the grounds they were uninformed by research and also made unwarranted assumptions that teachers welcomed both the technology and the associated changes within the National Curriculum (Dawes, 1999).

There was much enthusiasm for ICT in government and governmental agencies but little evidence that it conferred any educational benefit (Angrist & Lavy, 2002). Commentators also pointed to a tendency for the government to ignore research indicating that the provision of other, arguably more useful, educational resources was being displaced by the focus on ICT (Anderson & Becker, 2001; Culp et al, 2003). The economic benefits to be gained from ICT adoption in education was a feature of much government rhetoric at this time although again research suggested that such expectations were at best misplaced (Selwyn, 1999; Cuban, 2001). These instrumental approaches to ICT use within subject-specialisms or in the service of economic expectations for employability skills were also at odds with my personal experience of the impact of ICT on individual student learning, where the use of *Zork!* had suggested that higher order thinking abilities such as revision, analysis, synthesis and the use of imagination were more likely and more powerful generic benefits available.

Some research has suggested that school-level characteristics and teacher attitudes to change and technology also have a powerful influence on whether ICT is likely to be adopted (Becker, 2000) and that teachers' attitudes towards pedagogy and their subject and their existing practice also seem likely to

influence both whether and how they might take up ICT as part of their classroom practice (Loveless et al, 2001). The most productive applications of ICT appear to most commonly appear when it is used as part of student-centred learning irrespective of the software-type although teachers using other pedagogical approaches have found equivalent success, depending on the objectives being sought (Scrimshaw, 1997; Becker, 2000). Overall, however, early results were often variable (Parr & Fung, 2000) although there is strengthening evidence that ICT may be able to change the educative relationship between teachers and students that are argued to be important for producing increased learning (Cuban, 1998; Somekh, 2007) and a recognition that it is the attitudes, values and practices of teachers that are seen to most strongly affect outcomes from ICT use (Andrews et al, 2007). Ideally it might therefore be better to locate the study of multimedia applications with teachers in subject areas where high levels of skill and learning efficacy are thought to exist but where there are few preconceived notions or established practice regarding ICT use. This is the approach that has been attempted in the present study, as set out in the Methodology and case studies (Chapters 3, 4 and 5).

Whilst government priorities, national policy and teachers' pedagogy and attitudes provide an already complex context for understanding the relationship between technology and learning gains, other factors have made reaching a clear consensus on the benefits of ICT use problematic. Amongst these is the lack of agreement as to what constitutes the 'effective' use of ICT and, as a proportion of the many studies in this area, the relatively small amount of robust empirical research that has been conducted to compare gains from ICT use with more traditional approaches. As a result the relationship between ICT use and attainment has remained contested (Wenglinski, 1998; Kozma, 1994; Angrist & Lavy, 2002; Pelgrum & Plomp, 2002), although there is some evidence that prolonged use of ICT may bring about more student-centred, constructivist pedagogy, more positive attitudes to learning and enhanced collaborative skills (Kozma, 2003). What does seems clear is that notwithstanding the government's continuing enthusiasm for ICT use in schools (Ofsted, 2004), the mere presence of computers in schools or the home has little effect on learning, beyond the acquisition of some computer-specific skills, when other factors are controlled for (Fuchs and Wössmann, 2004); and that the provision of ICT may displace other valuable resources (Fuchs and Wössmann, 2004; Rouse, Krueger & Markman, 2004). The present study has attempted to take account of

these concerns by locating 'efficacy' within the context of GCSE Examination performance within English Literature, by the use of a comparative empirical study and by controlling for many contextual variables, as set out in the Methodology and case studies (Chapters 3, 4 and 5).

Within these debates, multimedia applications have often been identified as having particular promise for improving learning (Giardina, 1991; Squires & McDougall, 1994; Boyle, 1997; McNamara et al., 1998; Crawford, 1999). Such applications are thought by some to also have their greatest effect when they are used within the context of Learning Styles theory or Cognitive Load Theory (Kolb, 1984; Sweller & Chandler, 1994; Sweller et al, 1998; Mayer & Moreno, 2002; Mayer, 2003, 2009). It is therefore important to examine the possible application of Learning Styles and Cognitive Load Theory in understanding the educational impact of the multimedia package developed for English Literature teaching in the present study.

As discussed more fully above (see section 2.6) Learning Styles Theory has attracted considerable disagreement in published research with regard to both its theoretical coherence beyond mere personality and with regard to its empirical operationalisation and measurement. The next stage in the present study (Chapter 4) therefore focuses on research question 2(a), which is whether students have preferred styles of learning that should be incorporated into the design and use of multimedia software.

By the same token Cognitive Load Theory is applied to examine the outcomes from the use of the multimedia package in the present study in a number of schools and is the focus of research question 2(b), which asks whether multimedia software seems likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources. This examination is pursued in Chapter 5. Both Chapters 4 and 5 follow the methodology set out in Chapter 3, as informed by the literature review from the present chapter.

The next chapter discusses the methodology used to explore research question 2:

Can multimedia software enhance student achievement at GCSE level?

Within which two sub-questions are posed:

a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

CHAPTER 3 - Methodology

3.1. Introduction

This chapter discusses the research methodology and methods used for examining the research questions and for the associated empirical work reported in Chapters 4 and 5. The chapter begins with the research questions and the conceptual framework for the current study and then goes on to discuss the research methodologies, which are mixed methods and case study. The rationale for the sampling strategy and for the case study are discussed next. Following this the methods for the collection of quantitative and qualitative data are presented and the procedures for data analysis are demonstrated. The chapter concludes with a discussion of the limitations of the research, including a consideration of validity, reliability and ethics.

Two related but separate studies were conducted, as outlined in the Introduction (Chapter 1). The first study arose from considerations of the usefulness of learning styles and the need to evaluate learning styles in order to establish the potential for applying them in the assessment of the multimedia software that was developed and used in this study. The second study related to the use of Cognitive Load Theory in the assessment of the multimedia software that was developed and used in this study and other classroom resources used by teachers to establish whether it was able to explain and predict the relationship between multimedia use, the format of instructional material and individual learning. These studies are discussed in this chapter, under the headings outlined above.

3.2 Research questions and conceptual frameworks

This chapter focuses on the research methodology for research question 2 and for its sub-questions 2(a) and 2(b):

2. Can multimedia software enhance student achievement at GCSE level?
    a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
    b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more

established or traditional classroom teaching and learning resources?

This chapter is informed by the discussion of relevant literature in the Literature Review (Chapter 2). The present section discusses the conceptual frameworks within which the sub-questions of research question 2 are located.

The use of multimedia has been argued to have the potential to significantly improve instructional efficacy, particularly with regard to the successful learning of information and the development of understanding (Mayer, 2008; Miller et al., 2011) but concerns persist about the degree to which its design and use have realised or optimised such potential (Argyris, 1976; Sweller & Chandler, 1994; Tabbers et al., 2000; Massa & Mayer, 2006; Schnotz & Kürschner, 2007). The application of Learning Styles Theory and Cognitive Load Theory (Kolb, 1984, 2005; Honey & Mumford, 1992; Sweller et al., 1998) have been at the forefront of much theoretical and experimental work in this area and have also articulated important implications for optimising the design of educational multimedia such as that used in the present study (Mayer & Moreno, 2002; Mayer, 2003, 2009).

Chapters 4 and 5 report two associated but separate empirical studies: the use of learning styles; and the use of multimedia. Both of these are related to the teaching of English Literature and the likely usefulness of scores from instrumentation such as Honey and Mumford's (1992) LSQ, Kolb's (1985) LSI-2 and measures of cognitive load in conjunction with a measure of knowledge and understanding of Shakespeare's *Macbeth*. The subject of English Literature and the literary work that is Shakespeare's *Macbeth* were selected for the reasons set out in Chapter 1 (Introduction) and these are areas and topics where no previous published research on the use of multimedia, learning styles and cognitive load theory could be located. The use of *Macbeth* within GCSE English Literature teaching also represents an appropriately challenging setting for testing the theoretical basis and instrumentation commonly associated with learning styles, cognitive load theory and multimedia use and the reasons for this are to do with the nature of the subject domain and the objectives that teachers and public examination assessments seek to attain and assess within this.

Teachers of English Literature in the UK generally seek to encourage the growth of a number of broad skills and abilities in their students as part of their preparation for public examinations such as the Standard Assessment Tests (SATs), the General Certificate of Secondary Education (GCSE), or Advanced Level studies (GCSE Advanced Levels), whilst also taking into account the requirements of relevant examination boards, as set out in their subject syllabuses. Desired outcomes for dramatic works or novels, for example, are likely to require students to demonstrate:

- Recall of a sequence of events (the story or plot) in their correct sequential order;
- Understanding of the structure of the narrative;
- Recall of the names of and family relationships between characters;
- Insight into the individual characteristics and traits of characters;
- Knowledge of the dramatic relationships between characters;
- Awareness of the main themes and images present in the work;
- Recognition and understanding of the dramatic structure of the text;
- Understanding of how dramatic elements (e.g. themes and imagery) interact to create meaning and reveal insight;
- Understanding of how each dramatic character is developed;
- Understanding of historical or social influences;
- Understanding of the human condition including spiritual, moral, ethical social and cultural issues.

(adapted from AQA, 2011a; Edexcel, 2010)

In order to achieve high levels of performance in public examinations, regulatory bodies expect students to master and display knowledge, understanding, insight and appreciation of these kinds (AQA, 2008, 2009; Edexcel 2009). To facilitate the development of such learning, teachers commonly draw upon personal enthusiasm and make use of their instructional skill to encourage the high levels of student motivation and engagement which are normally necessary to develop the close familiarity with the text and the critical thinking and analytical skills which are needed. As part of this, teachers often make use of a range of different techniques and resources to encourage and promote learning.

Despite such efforts, students often find the study of English Literature difficult because of the inherent complexity of the subject matter and the ways in which this is expressed, where many elements may be closely interrelated and because, as part of their preparation for examinations, they often have to be able to apply their learning to alternative contexts, such as when discussing the contribution of one character or element of a literary or dramatic work to the other specific elements or structural features of that work, or to those of a

different literary work, e.g. one created by the same author or by a different author writing about a similar theme or context (see CEA, 2010, 2011; Edexcel 2008, 2009a, 2009b). Achieving high examination results in English Literature requires students to display knowledge, understanding and insight that can be gained only by effectively memorising, analysing and synthesising many pieces of information, i.e. many discrete interacting elements (AQA, 2011a, 2011b; Edexcel, 2010).

In learning and teaching scenarios such as these, the conceptual frameworks underpinning learning styles and Cognitive Load Theory differ in their approaches for the understanding and optimising of learning. Learning styles theory is based on propositions about how to leverage optimum learning by using one or more of a limited number of different but established and preferred thinking and learning habits that it proposes are used by each individual. In contrast, Cognitive Load Theory proposes that generic neurological mechanisms for learning operate in ways that are common to all individuals and that these mechanisms have implications for how instructional content and learning resources should be designed in order to achieve optimum learning outcomes.

Earlier experience with students in my own classes had shown that the multimedia software was popular and provided levels of engagement, enjoyment and motivation similar to those I had seen with students using *Zork!* and feedback from other teachers and schools using the software was similar. Other schools and teachers also reported that their students found the software engaging and valuable for learning and many teachers also reported that after using it their students performed better than students in previous years who had not used this software. However, whilst these reports were encouraging and were in line with my initial and tentative perceptions, they were largely anecdotal because teachers were reporting their impressions and had usually either used the software in a wholesale way with all of their students or had not used it at all - so strict comparisons were not available. What was unclear therefore from the examination of the literature was which of the conceptual frameworks and approaches discussed above would prove most useful for understanding whether multimedia provided opportunities for greater learning and, if so, how this process might be operating.

The methodology for this study is therefore directed towards understanding the use and actual and perceived value of learning styles for teachers of GCSE English Literature (research question 2a) and the usefulness of a range of different types of classroom resource for promoting learning relevant for examination success (research question 2b). Each of these was the focus of two sequential and separate (but related) interventions to determine the implications of each of these for the design and use of multimedia software (research question 2).

3.2.1 Learning Styles - conceptual framework and the present study

I began to think about learning styles as I approached the empirical work with the multimedia application that I had created and began to consider the possible value of incorporating learning styles when using it as a resource for learning and evaluating its success. The possible value of learning styles was reinforced as a result of reviewing the literature (Chapter 2) and as I addressed research question 2(a). However, whilst personal experience confirmed the popularity of learning styles with many teachers in schools, the published research on learning styles indicated that there was often significant disagreement between those advocating their use and others who found many weaknesses in both the validity of the conceptual frameworks which underpinned learning styles and in the usefulness and accuracy of instruments purporting to measure them. Much of the published work on research into learning styles is also focused on their application in higher education, training and the adult workplace and no published work could be located that examined their use within English Literature teaching at secondary school level, or their use with students in the age range found in upper secondary schooling. It was not therefore possible to draw upon existing studies and their findings to directly address research question 2(a). As a consequence of this, it was important to first evaluate learning styles in an appropriate and relevant context to enable a decision to be made about whether they might usefully be incorporated into the application and evaluation of the multimedia software - and if so how - or whether the criticisms levelled against learning styles in existing studies were also appropriate in the context of the present study.

As described in the literature review (Chapter 2), one of the strongest and best known advocates of learning styles, Kolb (1984), set out a highly influential

conceptual framework underpinning learning styles that has been widely adopted. Kolb's framework and the instrumentation he developed from it influenced the design of many approaches to the conception and measurement of learning styles; Kolb's ideas are based on the theory that learning operates within a cycle of four iterative stages and that effective learners make active use of these four different stages (learning styles): *concrete experience*; *reflective observation*; *abstract conceptualisation*; and *active experimentation* (Figure 2.1). For each of these four stages/styles, Kolb describes an equivalent learning mode which he argues is characterised by certain kinds of *orientation* possessed by individuals which although influenced by situational factors and level of maturity are relatively stable over time and can therefore be used by educators to increase the effectiveness of instruction. Kolb proposes that learners and teachers are therefore able to use his Learning Style Inventory (LSI) to accurately identify the relative importance of each of these stages for an individual learner. This information might then be used to understand which style(s) a learner tends to emphasise, which could help them to improve their knowledge of themselves as learners and provide guidance for their teachers for making use of an individual's preferred style.

It was important for the present study to establish whether instruments designed to measure learning styles gave valid and reliable outputs in the context of English Literature, so that their use within this subject area could be evaluated and a decision then made about whether or not to incorporate them into the evaluation of the multimedia resource and what the implications of this might therefore be for the next stage of the study.

3.2.2 Cognitive Load Theory - conceptual framework and the present study

As was the case with the assessment of learning styles theory, the need to assess the potential value of using Cognitive Load Theory to study the effectiveness of multimedia for promoting learning was something that arose from a consideration of research question 2(b) in light of the literature review (Chapter 2).

To recap briefly, according to Cognitive Load Theory, the processing of information in human cognition takes place within a limited working memory (Baddeley, 1992) and so there exists the physical capacity to handle only a very

limited number of novel interacting elements at one time, possibly as few as two or three (Paas et al, 2003). Different kinds of information vary from simple to complex across a wide spectrum from information that has high element interactivity to that which has low element interactivity; this variation also often depends on the subject and the level of complexity of the actual content. Within the conceptual framework of Cognitive Load Theory, the importance of this for learning is that whilst an element of low-interactivity material can be learned and understood individually (because it does not require consideration of other elements) this is not the case for high-interactivity material such as that commonly found in the subject matter of English Literature courses.

Learning the names and activities of the characters in Shakespeare's *Macbeth* provides an example of low-element interactivity because each can be learned and understood without reference to any other items. This task imposes a relatively small cognitive load and may be handled easily. By contrast, learning how to describe the contribution of any one of the dramatic characters in *Macbeth* to the dramatic structure and meaning of the work as a whole provides an example of high-element interactivity. Similarly, arguing how one character may be seen in a positive or negative light cannot be done independently of other characters and events in the dramatic work, because reaching a conclusion on this requires knowledge and understanding of events, ideas and other characters and of how these all relate to each other; that is, the elements required for consideration interact.

The separate elements of high-interactivity material can be learned individually but understanding them requires all of them and their interactions to be processed simultaneously. This can make high-element interactivity material (such as is found many highly-regarded works of literature like *Macbeth*) difficult to understand, because it can impose a cognitive load that exceeds the processing capacity of working memory.

However, whilst such material may be more difficult to learn, it is clearly not impossible, as evidenced by the successful learning that teachers of English Literature see in students on a regular basis. The way in which human cognition research allows for the learning of high-element interactivity material is by way of long-term memory, which is an extensive store containing large numbers of *schemas*. The store of schemas is subject to addition or revision in the light of

further learning or new experiences (Bartlett, 1932; Neisser, 1967; Piaget, 1985). A schema may consist of a large number of interacting elements which, if they each had to be processed separately might easily exceed the capacity of working memory.

In the case of the illustration regarding *Macbeth* above, one example of a schema might be about behaviour, where a number of elements are combined to produce a classification of a character's actions as 'negative' or 'positive'. Schemas are hierarchical, domain-specific knowledge structures that categorise multiple elements of related information as a single higher order element. In this they differ from 'constructs' (as in Construct Theory) because they: (a) are cognitive rather than emotional or ethical; (b) do not necessarily represent or articulate our core values; (c) do not focus on our key personal relationships; and (d) are relatively easy to modify or change (Kelly, 1995). Controlling the use of schemas requires conscious effort on the part of the learner, but this can reduce with practice to the point where using a schema can become an automatic process rather than a controlled one.

In the present example, the elements being considered about the behaviour of a dramatic persona may include, selectively, characteristics or relationships that are seen as being either 'bad' or 'good', 'kind' or 'unkind', 'generous' or 'mean' and so on. Schemas for these characteristics and relationships can be retrieved from long-term memory and used in short-term memory, meaning that only a small number of elements have to be processed (used) in memory and the use of schemas may become automated so that they can be processed unconsciously to reduce further the load on working memory. According to Cognitive Load Theory, it is by these processes that complex material can be handled by human cognitive architecture when it appears to exceed the capacity of working memory.

This thesis explores the usefulness of multimedia in facilitating individual student attainment in English Literature through an experimental empirical study applying Cognitive Load Theory and through examining the potential contribution to this of learning styles in a number of schools. A pre- and post-intervention questionnaire for measuring each student's knowledge and understanding of *Macbeth* was developed in collaboration with the teachers involved in the study and completed by student participants. Student participants

also evaluated a range of classroom resources commonly used by their teachers, as well as the elements within the multimedia application, to rate each of them for the ease with which they were able to learn with each one. The student evaluations of resources were used in conjunction with the pre-intervention test to establish a measure of cognitive load and relevant prior learning, respectively.

These instruments were designed to explore the usefulness of their scores in assessing the effect of multimedia use on learning using matched groups of students and teachers in the schools and of the differing formats of instructional material (multimedia and non-multimedia).

3.3 Research methodology – Learning Styles

This section discusses the research methodology that was applied to research question 2(a):

> Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

There have been sustained criticisms of the conceptual integrity of the two approaches to learning styles used in this study but also many positive reports (discussed in the literature review in Chapter 2) and similar findings about the instruments used to measure learning styles. In order to answer research question 2(a) it would be important to establish whether instruments designed to measure learning styles give valid and reliable outputs in the context of the teaching and learning of English Literature, a study was conducted within GCSE English Literature classes in a selected group of schools. The rationale for the sample of schools and classes that were used is discussed below in section 3.5 (Rationale – sampling strategy). The Literature Review (Chapter 2) identified the prominent contribution of Kolb (1984, 2005) and Honey and Mumford (1992) to the conceptual frameworks and instrumentation used for understanding and measuring learning styles and schools with appropriate experience of these instruments were involved in the study. The two instruments developed by Kolb and Honey and Mumford were used: the Learning Styles Inventory-2, LSI-2; and

the Learning Styles Questionnaire, LSQ, respectively. The LSI-2 instrument can be found in Appendix 1 and the LSQ instrument in Appendix 2.

As indicated in the literature review, although reasonable internal consistency might be expected for an individual's scores on an instrument such as the LSI-2, its context dependency (Kolb, 1984) and age sensitivity (Cavanagh & Coffin, 1994) - as also that of the LSQ - might introduce variability when no context is specified. To minimise the effects of this the methodology of the present study gathered data from students from English Literature GCSE lessons only, by completing data collection during one class period in this subject with their normal teacher present and by asking all participants to focus only on the learning with regard to that subject and context when making their responses. Students completed the Kolb LSI-2 and the Honey and Mumford LSQ consecutively as part of a normal Year 11 GCSE English Literature lesson and a total of 394 complete sets of matched data were obtained for each subject (Table 3.3).

School	Male	Female	Totals
A	64	69	133
B	49	51	100
C	0	102	102
D	28	31	59
Totals	141	253	394

Table 3.3 Nature and numbers of students in sample for the present study.

This approach was intended to ensure low discontinuity of subjects' experience and to minimise any variability in the learning context that subjects may have visualised during testing, which has previously been identified as a potential contributor to problems of validity (Willcoxon & Prosser, 1996; Wierstra & de Jong, 2002).

Additionally, to mitigate the possible effect of a response bias in the LSI, the order of the alternatives was adjusted so that each of the four modes appeared with equal frequency within the first, second, third or fourth position in the questionnaire. This was intended to prevent the instrument producing a positional response set in the data, which has previously been identified as a potential weakness of the LSI in several studies (Atkinson, 1988; Veres, et al,

1987, 1991; Cornwell, Manfredo & Dunlap, 1991; Wierstra and de Jong, 2002) and removing the patterned order of alternatives has been found to much improve its reliability (Veres, Sims & Locklear, 1991).

The outputs of the LSI-2 and LSQ were correlated in line with their theoretical pairings to discover whether these match at the theoretical level and a graphical expression of these created for visual inspection. The percentage of the sample extracted by the LSI-2 and LSQ onto their different learning styles was compared to discover how far they matched the theoretical equivalences. Following this, to check the internal validity of the subscales against the learning style constructs, exploratory principal component factor analysis was used to determine the underlying constructs within the data for the LSI-2 and LSQ using the eigenvalue ≥ 1 rule in conjunction with scree plot tests as recommended by Nunally and Bernstein (1994, p.447). The number of salient variables was determined by selecting those which gave loadings of at least ± 0.40 on extracted components and by using orthogonal (varimax) and oblique (oblimin) factor rotations to determine which gave the most meaningful structures. Although a quartimax extraction would likely have made interpretation of the variables easier, this method can often result in many variables loading onto a single factor. To avoid this a varimax extraction was used so as to maximise loading dispersion onto more factors and produce an output where a (possibly smaller) number of variables were more likely to load heavily (and therefore be clustered) onto more factors. The varimax extraction is also more suitable when factors are expected to be independent, as is the case with the LSI-2 and LSQ, in line with the orthogonal nature of their theoretical underpinning. An oblique (oblimin) rotation was applied in order to maximise the loadings of variables onto the factors to which they relate most but the default values in SPSS (where delta is zero) were retained to avoid factors becoming highly correlated - in such a case a direct oblimin rotation is recommended as being more appropriate (Field, 2006, p. 636; Nunally and Bernstein, 1994, p. 493).

3.3.1 Interviews with teachers - Contemporaneous notes

In addition to the use of the LSQ and LSI-2, discussions were held with teachers involved in the study to present the findings from the questionnaires to them and to gain their views and encourage their reflection on these. The intention of these discussions was to probe their professional reactions to and observations

of the research findings from this part of the study. These discussions were held during lunchtimes or after school in one of the schools concerned and involved all of the 18 teachers whose 16 classes were included in the study. Individual interviews with teachers were also conducted to follow up findings from their students and to confirm the accuracy of verbatim quotations from them that seemed likely to be used in the writing up of the research. Contemporaneous notes were taken during discussions and individual interviews.

3.4 Research methodology – Multimedia and Cognitive Load Theory

This section discusses the research methodology that was applied to research question 2(b):

> Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

Chapter 5 reports the experimental empirical study of the use of multimedia in the teaching of English Literature and the effect of its use on scores from a measure of knowledge and understanding of Shakespeare's *Macbeth*. Cognitive Load Theory was used to explore the relationship between the pre- and post-intervention scores for students' knowledge and understanding and the types of classroom learning resources that they used during the intervention.

The methodology for this section of the study draws on previous work in which differences in expertise were found to give the largest and most reliable explanation for differences in performance between individuals during learning. The design of the methodology also took account of Kalyuga et al. (1998), who found that subjective ratings of mental effort, i.e. the mental effort associated with learning the instructional materials, was an effective and accurate proxy measure of cognitive load. The present work follows Kalyuga and adopts the use of subjective ratings of mental effort with exemplar learning materials as an ecologically valid and reliable proxy for prior learning (and therefore for a main element of intrinsic cognitive load) when comparing the learning gains of groups which were using either existing or alternative (multimedia-based) approaches

to learning, allowing for different levels of cognitive load attributable to the instructional materials.

Experimental and control groups were compared to explore the degree to which the use or non-use of multimedia resources mediated any gains for learners with similar subject expertise when learning complex and demanding content. The intervention (the multimedia resources) was designed deliberately to reduce the cognitive load on students and was intended to ease the difficulty of learning (cognitive load) presented by complex material and (according to Cognitive Load Theory) its associated overload of short-term memory.

Previous studies have used subjective mental effort ratings to measure overall cognitive load (see Paas, 1992) and found that learners who experienced the same overall cognitive load achieved different learning outcomes (Tabbers et al., 2000). This may be due to increases in extraneous load being accompanied by decreases in germane load with some learning formats and *vice versa* with other learning formats, or to the prior learning of students, or their intrinsic abilities or interest in the topic.

To test whether differences in learning outcome are caused by germane load attributable to the format of instructional materials, a closer measurement of cognitive load is required. Using the text of *Macbeth* as the target area of study, differences in the extraneous cognitive load imposed by two different instructional designs were explored with one set of groups using multimedia (the experimental group) and another (the control group) using only teachers' established, routine approaches to teaching the same subject matter. It was expected that the germane load imposed on students by these different approaches could therefore vary. Following Kalyuga et al. (1998), a measure of prior knowledge was used to allow for individual differences in intrinsic cognitive load attributable to learner expertise (Appendix 6). This test was also re-used after the period of involvement with the multimedia resource and the differences between the two scores used as a measure of the individual's gain in knowledge and understanding.

Subjects were also asked to record how difficult it was for them to learn using different resources, by rating the ease of learning (i.e. mental effort) they associated with different instructional materials for the plot, characters and

themes and imagery on a five point Likert-type scale from 1 (extremely difficult) to 5 (extremely easy) (Appendix 3 - Questionnaire). Subjects rated 23 exemplar teaching resource materials representative of the repertoire of resources used by teachers in the four schools, for the degree to which subjects found them easy to learn from; they also similarly rated 32 generic elements from multimedia titles from the same series as the *Macbeth* resource (Appendix 4 - Sample Booklet).

Prior to the study teachers within the four schools checked their existing and the multimedia resource content against a collectively-constructed measure of knowledge and understanding which was applied pre- and post-intervention to ensure that measures of relative change in scores could be meaningfully used for both experimental and control groups and that the test included measures of knowledge and understanding that could be gained equally from all resources (Appendix 6).

The test was a thirty-item paper-based assessment that was completed individually by participants in the normal class session immediately preceding the start of the intervention and before the study of the selected text began. There were ten questions about key characters in *Macbeth*, ten about important themes and images found in the play and ten about its structure and cultural context. Each section of the test included questions in open-ended, multiple-choice and short essay formats (Appendix 6). The post-test used this same instrument and was completed under the same conditions ten or eleven weeks later (variations being due to differing lengths of half terms between schools).

In order to reduce the strength of any possible Hawthorne Effect (potentially generated by the letter to parents informing them about the study - see page 289), where an increase in ‘productivity’ (scores on the knowledge and understanding test) could be produced by the psychological stimulus of being singled out and made to feel important (Franke & Kaul, 1978), students using the multimedia application were told that this was simply one of several resources used for studying the text, that they may or may not find it useful but that, by itself, it was not expected to make any real difference to their learning, as this would be mainly the result of how hard they worked in class and on their homework study tasks. Students were not informed of their results from the pre-test, or that the test would be re-used at a later date.

The experimental groups used a specially developed multimedia application in their English Literature classes for approximately one hour (one lesson from their allocated two) per week over ten weeks (Appendix 8 - *Macbeth* Multimedia CDROM; Appendix 9 - Software design, operation and content). This application covered the syllabus-relevant content for the text being studied. The control groups studied the identical content to the experimental groups during their English Literature classes (and in the same sequence and time period), with the same teacher, but they experienced only the teacher's usual approaches to teaching and learning and they used the learning resources their teacher normally employed.

Each experimental and control group had two lessons per week of around one hour each, with one of these lessons being supplemented by multimedia use for the experimental groups. Teachers in each school were provided with an induction session on the operation and use of the multimedia package to be used. Technical staff in each school worked with the researcher to set up and test the software so that it was available for students on the school computer network prior to use with the experimental group classes and to ensure that access was provided only to those students (through controlling student login accounts) in order to reduce the possibility of students in the non-multimedia groups being able to gain access to the multimedia resource.

The learning resources used by the experimental and control groups were comparable in terms of the information being conveyed, being closely related to the text and the subject syllabus specifications for the public (GCSE) examination that students were preparing for. The existing paper based learning resources of teachers included worksheets, summaries of various elements of *Macbeth* (biographies of characters, timelines of events, etc.), drawings, illustrations, sample questions and worked examples (for examples, see Appendix 5 - Sample Booklet of exemplar resources).

The experimental groups had one of their two lessons per week replaced by a laboratory session using the multimedia software, under the direction of their usual teacher. The control group had both of their weekly lessons with their usual teacher but had no contact with the multimedia resource used by the experimental group, although no measures were taken to prevent the two

groups discussing their classes with each other**,** as this was impractical and could have risked inadvertently invoking the Hawthorne Effect. For each teacher, the control group(s) followed the same sequence of content study in their classes as those in the group(s) which were using multimedia.

3.4.1 Interviews with teachers - Contemporaneous notes

Both before and during the interventions in the four schools a number of meetings were held between the researcher and technical staff and (separately) teachers from the schools, either individually or in groups. These meetings were held for a range of purposes: initially they were to discuss the requirements of the project; supply necessary training or technical information (e.g. for the IT technical staff in the schools to set up the software and arrange student access for the experimental groups only); then to design some of the instruments used with students (e.g. the test of knowledge and understanding); and finally to review and discuss the research outcomes. In many of these meetings and especially those held at the end of the project to discuss its findings, contemporaneous notes were taken by the researcher. Sections of these notes were reviewed as necessary with groups or individuals - either at the time or subsequently - to ensure the accuracy of notes and especially of those that were to be used for actioning agreed arrangements (e.g. the dates of commencement with the project, schedules of classes, etc.) or used for writing up the research, such as any verbatim comments that were likely to be used to inform analysis. This process helped to ensure the accuracy and interpretation of notes that were subsequently used for running the project or used as direct quotations, such as the comments about teachers' use of leaning styles found in Chapter 5.

3.4.2 The English Literature software

A networkable multimedia application was provided for each school to support individual and group learning about Shakespeare's play *Macbeth*. The application was from a series of computer programs created to support the study of a number of individual English Literature texts (listed in Appendix 6).

The Shakespeare title was selected above others after consultation with faculty because they felt that *Macbeth* provided a particularly suitable challenge for many learners in terms of its mature thematic content, its subtlety of

characterisation and imagery, its cultural specificity (historical setting) and its complex language containing multiple layers of meaning. Faculty agreed that *Macbeth* was typical of subject matter that imposed on learners unavoidably high intrinsic cognitive load and was commonly seen by learners as 'difficult'.

The multimedia application was custom-built to the common design template that was used for the series from which the resource was taken. Packages in the series are available for a number of the most popular texts prescribed for use in many examinations at Key Stage 4 (K11-K13): George Orwell's *Animal Farm*; Charles Dickens' *Great Expectations*; William Golding's *Lord of the Flies*; Shakespeare's plays *Macbeth* and *Romeo and Juliet*; John Steinbeck's *Of Mice and Men*; Mildred D. Taylor's *Roll of Thunder, Hear My Cry*; and Harper Lee's *To Kill A Mockingbird*.

The Macbeth software resource covers similar content areas to the non-multimedia resources used by teachers in the four schools but, additionally, included interactive multimedia features such as: spoken commentaries accompanying illustrations; interactive maps and timelines about the story; interactive audio translations of archaic or specialised technical language; hyperlinks between the text and explanations of relevant cultural background or links to similar themes or images; and discussions or definitions of relevant dramatic features or ideas, as well as pre-programmed feedback responses (such as the context sensitive responses to questions answered that are discussed above) in a graphic user interface featuring pictorial menus and icons designed around screens with interconnected elements. These features were designed in light of my practical teaching experience but within them were included features that would be characterised within Cognitive Load Theory as being 'integrated' in the way they incorporated different types of media in ways designed to complement each other to provide learning experiences.

3.4.3 Multimedia resource design and construction

The multimedia resource used in this study is designed to run from a CDROM on any standard personal computer using the Windows operating system (versions 3.1, 3.11 or 95-98 onwards). Minimum hardware requirements for operating the software are: 486D x 100 processor; 16 MB RAM; 8 MB of free hard-disc space; graphics card and monitor capable of running at 640 x 480 (the

display is fixed at this resolution, at which it is best viewed), 256 colours; Netscape or Explorer `Internet browser; mouse / similar pointing device; 16 bit sound card; CD drive.

The software was designed and built by the author using *Multimedia Toolbook II Instructor,* version 8.0, purchased from the American company Asymetrix Inc. (now trading as Click2Learn and marketed via SumTotal Solutions at http://www.sumtotalsystems.com/products/toolbook-elearning-content.html) and was then compiled to run automatically on a standard PC set to a screen resolution of 640 x 480 pixels, which was the commonest format used in schools at the time the resource was designed.

All content was entirely created by the author except for the text of the literary work(s) used, their original literary sources and the following elements used in the multimedia package: the graphics, which were commissioned from a graphic artist to the author's specifications (http://www.druksgraphics.com/); musical audio accompaniment which was purchased from Flying Hands, in Louisville, Kentucky, USA (http://www.flyinghands.com/royalty-free-music.html) and Chameleon Music of IQMS Music (company now defunct); and voice-over audio recordings which were commissioned from Kirk Foster of The Market Theatre, Hitchin, Hertfordshire, who was recorded speaking to a script written by the author. A copy of the multimedia package for *Macbeth* can be found in Appendix 7. See http://www.literature.co.uk for other titles in the literature series mentioned in the following text and elsewhere in this thesis.

Each of the literature applications contains text, sound, graphics, animation and interactive context-sensitive elements and graphically rich interface designs which provide the student with access to relevant information, support and learning resources. The multimedia features of the software provide opportunities for learning in ways and formats which, although initially developed from practical teaching experience, are also more consistent with current theories of how people learn, including that presented in Cognitive Load Theory, which are not based on the less effective approach of what can be called information delivery, where learning is seen as the addition of more information to memory and teaching involves delivering the information to the learner, commonly through words (Mayer, 2003). Throughout the software, learning resources are most frequently presented in 'integrated' formats which avoid the

'split-attention' effects that Cognitive Load Theory argues are less effective for learning, especially for students with relatively little expertise and experience of the content being addressed.

Without direct experience of using the software it may be difficult to imagine it – especially how it appears and operates - or to gain an idea of how it sets about achieving the provision of learning opportunities through integrated content and multimedia. In view of the strong effect on learning that this resource produced when compared to the other (much more familiar) types of resource used by teachers and students in the schools in the present study (reported in Chapter 5), an overview of the content and behaviour of the software is given below. A more extensive version of this overview with more examples and a fuller explanation can be found in Appendix 8.

The content of the multimedia resources in the series (including that for *Macbeth*) cover: the text and its main literary sources; interpretations and explanations of dramatic structure and style, characters, themes, images and language; an interactive presentation of the text itself (if free of copyright) together with features allowing for its study, interrogation and understanding; relevant cultural, scientific and philosophical background to the text and for the historical period; chronological sequences and explanations of the plot and main sub-plots; explanatory photographs, charts, diagrams and maps for relevant locations and events; and biographical information about the author as related to the text.

The opening menu offers pupils a number of areas and approaches to studying the text and these can be used in any sequence to suit the student's prevailing needs or interests. The general structure and layout across the range of titles in the series is broadly similar but examples given here relate to the *Macbeth* resource used in the present study. The topics and elements covered by the opening menu (Figure 3.1) include icons (animated opening and closing 'lockets' activated by a mouse-click) which lead to resources about: the plot ('Story'); the main dramatic characters ('Characters'); the main themes and images ('Themes'); the background to the literary work and the historical period in which it was written ('Background'); a section containing a range of questions about the literary work ('Quiz'); a section allowing for the location of words, ideas, themes, characters or other items within the original text or within an extensive

commentary on the play ('Tracker'); access to the internet ('Internet'); and an option to exit the software ('Exit'). Clicking (opening) the 'locket' for a topic reveals a number of buttons inside which are labelled with the various features or elements for that topic that are available. Each of the main elements is discussed and illustrated in the sections which follow.

Figure 3.1 Main opening screen of *Macbeth.*

3.4.3.1 The Story

Inside the 'Story' locket are two animated buttons - one labelled 'Tell' (for telling the story) and the other labelled 'Test' (for testing the student's recall of the story). As progress is made through the sequence of lockets, first down the left hand side of the main screen and then down the right hand side, the intellectual challenge and complexity of the material and the depth to which the content of the play is examined tends to rise until the 'Internet" and 'Exit' lockets are reached. This first 'locket' is therefore intended to give a simple introduction to the play and to familiarise students with the main events in the plot, although throughout the software students are frequently directed to other relevant sections of the material it contains and to specific locations within the text being studied that are relevant to the particular topic or area of study they are pursuing.

Figure 3.2 Main ('Tell') story elements in *Macbeth*.

1. The meeting between Macbeth, Banquo and the Witches on a desolate heath.
2. Lady Macbeth angrily tells Macbeth that they should murder King Duncan.
3. Alone at night, Macbeth waits for the signal to go and murder Duncan - he sees a ghostly dagger floating in front of him.
4. In the middle of the night, Macbeth murders King Duncan.
5. Macbeth is now King, but is afraid and does not trust anyone. He plots the murder of his friend Banquo.
6. Banquo is murdered but his son Fleance escapes.
7. Macbeth has a great feast to celebrate becoming King, but Banquo's ghost appears and frightens him. He vows to go and see the Witches to find out what his future will be.
8. The Witches show Macbeth three visions of the future that frighten him so much he decides he must carry on killing in order to remain safe as King.
9. The first vision was about Macduff, so Macbeth has everyone in Macduff's castle killed, but although all Macduff's family are murdered, Macduff himself is not there.
10. Lady Macbeth is having terrible dreams where she imagines she cannot clean her hands of blood stains.
11. Duncan's son, Malcolm, brings an army to defeat Macbeth at his castle in Dunsinane. The army conceals its true size with branches from trees. The second vision that the Witches showed Macbeth said he would never be defeated until Birham Wood travelled to Dunsinane, so Macbeth thinks now he will lose the battle.
12. At the end of the play Macbeth feels betrayed by the Witches. He is killed by Macduff and Duncan' son Malcolm becomes the new King.

Via the ‘Tell’ button, the outline story (plot) of *Macbeth* is recounted through pictures on five consecutive screens (Figure 3.2). When the mouse is moved over the separate numbered pictures on each of these screens, this activates a spoken commentary for each one that provides a summary of the story for that section of the play and also suggests some important questions and ideas for the student to consider. A précis of the commentary spoken for each of the numbered pictures is given in Figure 3.2.

The ‘Test’ button inside the ‘Story’ locket leads to a screen depicting a library (Figure 3.3) with several books titled Act 1, Act 2, Act 3, Act 4 and Act 5. Each of these books, when clicked with the mouse, leads to screens which test the student’s knowledge of events within that Act (Figure 3.4 shows an example from the book ‘Act 4’). One additional book titled ‘Get into Order’ leads to screens where the student has to supply the correct Act for a list of events in the play (Figure 3.5).

Figure 3.3 The main ‘Test’ screen for the story elements in *Macbeth*.

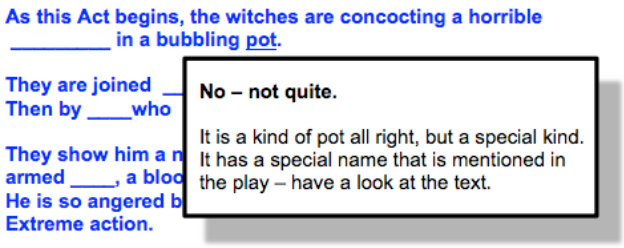


Figure 3.4 A 'Test' element from the content that is opened when the 'Act 4' book is 'opened' in Figure 3.3. showing a 'cloze' (fill-in-the-blank) format, with interactive feedback for the incorrect answer "pot".

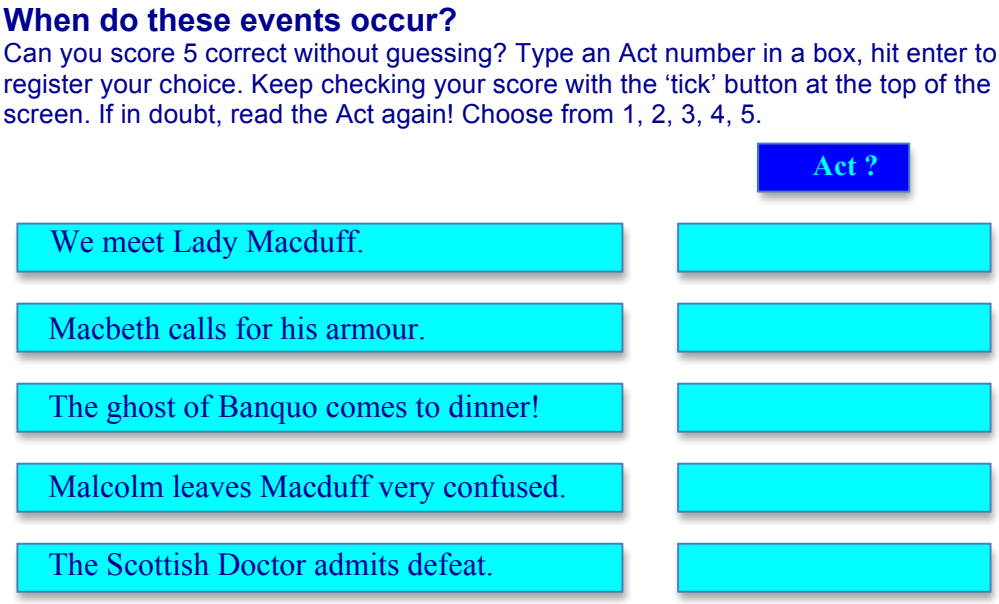


Figure 3.5 Sample question format from the 'Get into Order' book.

As with all the 'Test' sections throughout the software, the question formats incorporate context-sensitive feedback for correct, partially correct and incorrect answers. Feedback to answers is designed to promote further learning by offering affirmation, reinforcement for correct answers, additional learning, suggestions, prompts and hints or a factual answer and it often also directs the learner to another area of the resource for additional help or information and to specific locations within the physical text being studied.

Each multimedia package therefore contains a range of integrated multimedia resources for exploring and understanding content and for the teaching and testing of many elements within the literary work, including its story (plot), language, characters, themes and imagery, its dramatic structure and its cultural context.

3.4.3.2 Characters

The dramatic characters in *Macbeth* are varied and complex and perform sometimes very different functions within the structure of the play. The second 'locket' down the left hand side of the main screen deals with the Characters in the play. The 'Teach' and 'Test' options offered within the 'Characters' locket on the Main Menu screen (Figure 3.1) lead to content designed to improve the learner's understanding and memory of the most important things about the actions, speeches and significance of the dramatic characters in the play, including the 'minor' characters.

The panel below the main working area of the screen always shows the user which section of each 'locket' content they are currently viewing. For example, Figure 3.6 shows the different messages that are displayed when the 'Teach' and 'Test' options are selected after opening the 'Characters' locket.

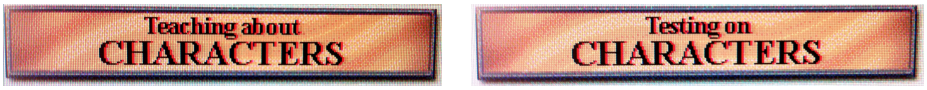


Figure 3.6 Notifications to the user for the 'Teaching' and 'Testing' modes.

Figure 3.7 Characters: Interactive menu functionality.

Moving the mouse over the main working area display for 'Characters' (Figure 3.7) reveals a 'scroll' showing the name of each character(s) as the relevant part of the picture is passed over and clicking each of these interactive parts of the picture provides access to information about the relevant dramatic character(s) in *Macbeth*. Changes in the background colour are made to the 'Teach' and 'Test' main screens to distinguish them, although as with other menus offering 'Teach' and 'Test' alternatives, this information is also shown below the main working area of the screen (Figure 3.6).

The examples given below (Figures 3.8 to 3.17) illustrate representative content material for a small selection of the characters in the play and that are dealt with in the software. A variety of different 'Test' question formats is used and only a sample is shown below, to illustrate this variety and the differing level of challenge that is presented using these formats.

Often the 'Teaching' and other sections of the software include spoken voice-over information to supplement the text or images shown on the screen and therefore users were advised, throughout the use of the software, to have the computer's sound turned up, or preferably to use headphones, so as to hear these.

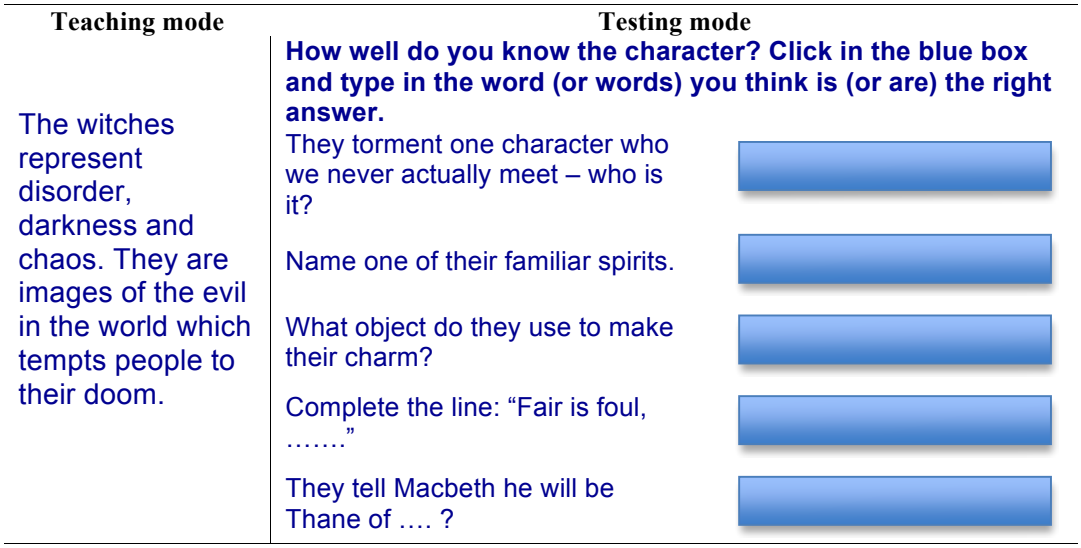


Figure 3.8 Teaching and Testing content for the characters The Witches.

As with every instance of ‘Test’ questions in the software, typing an answer provides context sensitive feedback which is also often designed to aid further learning, either by giving more information or providing hints and links back into the text of the play so as to develop deeper understanding. In the example above (Figure 3.8), typing the correct answer “Cawdor” for the last question produces the response:

> **Very good.**
>
> This is one of the things that convinces Macbeth that they may be telling him the truth about the other things that they say are going to happen. What Macbeth doesn’t at first realise is that they don’t always tell him all of the truth, just parts of it – and even then, what they say is very ambiguous.

… whereas typing an incorrect answer for the first question produces the response:

> **No.**
>
> This isn’t too complicated. A one-word answer will do. Check near the start of the play for information on this, or search the text for “Aleppo” for the exact reference. (Hint: ‘Aleppo’ isn’t the answer, but it will take you to the line in the play that contains the answer.)

Note that the suggestion here about ‘searching the text’ would normally be an onerous task that pupils would be unlikely or unable to complete, but this can be accomplished very easily using the features provided via the ‘Tracker’ locket on the Main Menu screen of the software.

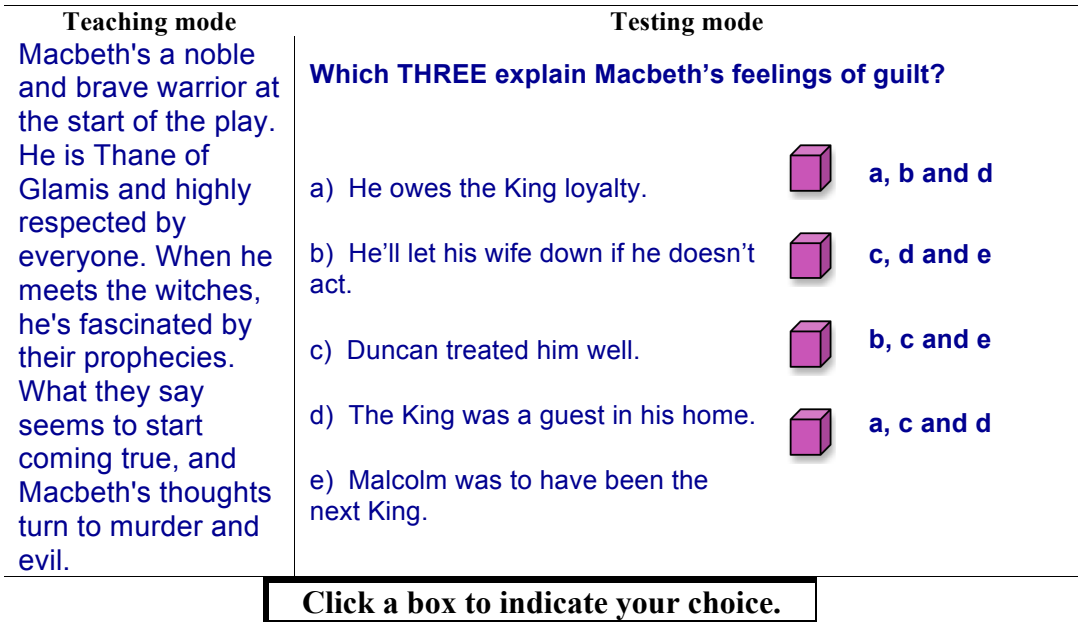


Figure 3.9 Teaching and Testing content for the character Macbeth.

The 'multiple-option' format shown in Figure 3.9 is an example of a more demanding question. Selecting the first (incorrect) option produces:

> **Wrong.**
>
> What does the question ask you to look for? Do **a**, **b** and **d** all deal with guilt, or is one of them more about Macbeth being accused of cowardice?

Typically, the correct (last) option produces quite a full explanation of why this is the best answer:

> **Good.**
>
> Macbeth does owe the King his loyalty – he's a soldier in his army and one of his subjects. Duncan has also treated Macbeth very well – he has made him Thane of Cawdor and praised him in front of his noblemen. And when Duncan is a guest in Macbeth's home, he should be able to rely on his host to protect him from harm, instead of which Macbeth murders him with his own hands.

Throughout the software package, the purpose of this kind and level of feedback is to ensure that even when pupils select answers wholly or partly by using guesswork, the software attempts to help them understand more fully why the chosen answer is correct.

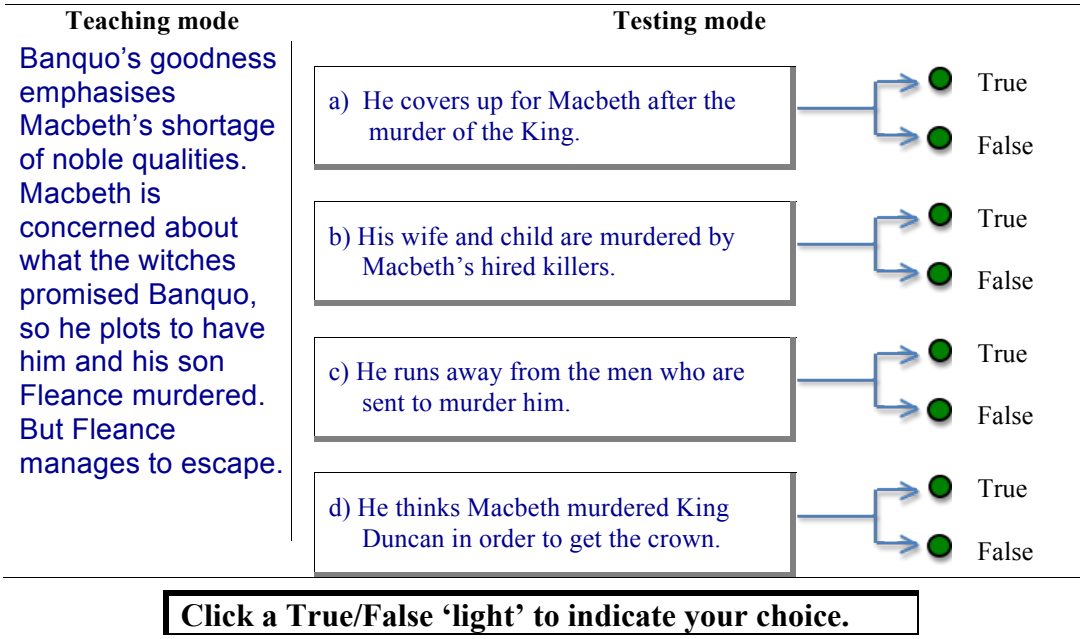


Figure 3.10 Teaching and Testing content for the character Banquo.

True / False-type questions (Figure 3.10) also produce explanations when responses are made – again the intention is to produce learning at all times. For example, selecting 'False' in the second 'Testing' item in Figure 3.10 produces a response designed to clear up the frequent confusion in students' minds between which families that are – and are not – murdered by Macbeth:

> **Yes – this is the correct response.**
>
> It's Macduff whose wife and child are murdered by Macbeth's men. Although we know Banquo has a son, there is no reference in the play to him having a wife.

An 'Other Characters' menu also covers what were usually termed 'minor' characters, many of whom perform important dramatic or structural functions within the play and are not in that sense minor at all. It is therefore important for students studying *Macbeth* in preparation for public examination to understand the role of these other characters and what they contribute to the dramatic action.

3.4.3.3 Themes and Images

Interactive icons on the graphic user interface provide access to ‘Teach’ and ‘Test’ information on and background to the main themes and images in the play (Figure 3.11).

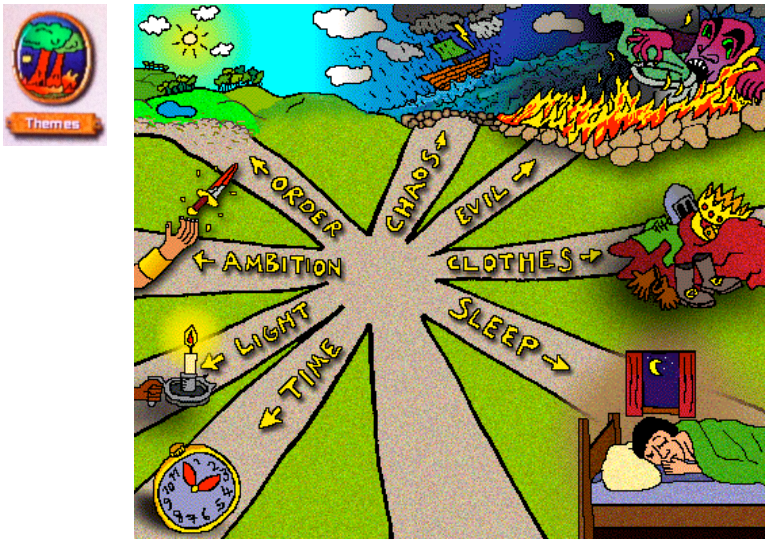


Figure 3.11 Themes: Interactive menu functionality - Key themes operating within *Macbeth.*

These give examples of how images and themes are expressed in the text, what resonance their use may have had for audiences at the time and how they create or emphasis dramatic effect. Again, the ‘Test’ formats provide questions, with context sensitive feedback, to reinforce learning.

3.4.3.4 Background to the Text and Age

Clicking (opening) the ‘Background’ locket on the Main Menu screen (Figure 3.1) reveals two options: ‘Text’ and ‘Age’. Figure 3.12 shows the menu screen which appears if ‘Text’ is selected; Figure 3.14 if ‘Age’ is selected.

Figure 3.12 Background to the text: Interactive menu.

Interactive icons on the ‘Background to the Text’ graphic user interface (Figure 3.12) provide access to information on and background to the Text for: biographical information about Shakespeare; a chronology of the text; where some of the source material for *Macbeth* is thought to originate; the 'geography' of locations mentioned in the play; some ‘recipes’ of the time; historical ‘photographic’ views (sketches) of Stratford-Upon-Avon; and a chart of family relationships between the characters in the play. These references and resources are designed to help students gain an insight into the background of the play’s action and setting or to gain understanding of the dramatic origins of the story and drama; an example is given in Figure 3.13 – the full text of the Holinshed source for the drama.

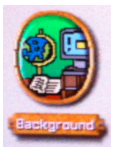
The text of Holinshed

This section provides a fully searchable copy of the text for the Holinshed original together with embedded commentary and explanation to link it to Shakespeare's version.

We now return to Macbeth's history, at the point where he meets the witches in Act 1 Scenes 3:

Shortlie after happened a strange and vncouth woonder, which afterward was the cause of much trouble in the realme of Scotland, as ye shall after heare. It fortuned as Makbeth and Banquho iouirnied towards Fores, where the king then laie, they went sporting by the waie togither without other companie, saue onelie themselues, passing thorough the woods and fields, when suddenlie in the middest of a laund, there met them three women in strange and wild apparell, resembling creatures of elder world, whome when they attentiuelie beheld, woondering much at the sight, the first of them spake and said: "All haile, Makbeth, thane of Glamis!" (for he had latelie entered into that dignitie and office by the death of his father Sinell). The second of them said: "Haile, Makbeth, thane of Cawder!" But the third said: "All haile, Makbeth, that hereafter shalt be king of Scotland!"

Figure 3.13 Exemplar content for 'Source'.




Mythology and Bestiary


Elizabethan sports


Astronomy and the Elizabethan Universe


The nature of human kind


Life in Elizabethan England


Alchemy


Magic and Superstition


Medicine


Education


The Four Humours


Chronology of the Age


Music

Religious beliefs

The Ladder of Creation (Great Chain of Being)


Travel and voyages of discovery

Figure 3.14 Background to the Age: Interactive menu functionality - Key aspects of the Elizabethan Age referred to in the writings of Shakespeare.

The ‘Background to the Age’ screen (Figure 3.14) provides a wide range of information about the Elizabethan Age and explains how the content covered by links from this menu is important in understanding much of the context, settings and references found in the dramatic works of Shakespeare and other dramatically relevant and related writers of the time.

Interactive icons on the graphic user interface for ‘Background to the Age’ provide access to information on and background to the Elizabethan Age and

also, where relevant, use examples to discuss where some of the references to each topic are to be found in the works of Shakespeare, what resonance they would probably have had for audiences at the time and the ways in which they were used to create or emphasis dramatic effect.

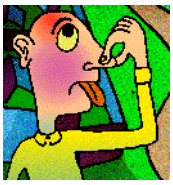
3.4.3.5 Quiz – Test Your Wits

The 'Test Your Wits' material in the Quiz Menu (Figure 3.15) covers the material found throughout the software and focuses on the ability of students to recall important facts, ideas and quotations that they will need when answering examination questions about *Macbeth*. Although the tone of much of the content is light hearted, the intention is serious and although answers and more information can be found within the rest of the software (and answers are provided to Quiz questions via a 'Dunce's' cap – not shown) the questions nonetheless include some difficult material that will challenge even quite able students.

The 'Teach' and 'Test' options offered within the 'Characters' locket on the Main Menu screen (Figure 3.1) lead to content designed to improve the learner's understanding and memory of the most important things about the actions, speeches and significance of the dramatic characters in the play, including the 'minor' characters. Much of this content, as elsewhere in the software, incorporates integrated features such as spoken explanation and commentary that is not replicated in the accompanying words or images.

Figure 3.15 Quiz Menu (Test Your Wits).

Interactive icons on the graphic user interface for ‘Background to the Age’ provide access to information on and background to the Elizabethan Age and also, where relevant, use examples to discuss where some of the references to each topic are to be found in the works of Shakespeare, what resonance they would probably have had for audiences at the time and the ways in which they were used to create or emphasis dramatic effect. A summary of what content each icon leads to is given below with a description (on the left-hand side under each icon) and on the right a brief précis of the content itself.



Disgusting stuff

These items test the student's recall of some of the (more revolting) events in the play.

As always, answers prompt feedback – here shown for an incorrect response to item two …

Who wants their blood to be made thick with evil?	
Who talks about urine?	
Who's left in a ditch with twenty gashes on his head?	
Whose nose is put in the witches cauldron?	
Who'd rather dash a baby's brains out than break their word?	
Who owns a pilot's thumb?	
Who chops people in half?	

No.

It's a character that acts rather like a Chorus (a commentator) on the action of the play.

What this character says also refers to the contemporary events to do with the Gunpowder Plot, which was a hot topic of conversation at the time the play was first performed.

NOTE: User answer typed in yellow boxes

Name that place
Asks students to identify important places or locations where events happen, such as the name of the wood that moves (Birnam), or the location of the first appearance of the witches (blasted heath).

Finish me off!
Asks student to supply the missing words from important quotations such as: "A little _____ clears us of this deed" (water).

Who said that?
Challenges students to identify the speaker of important quotations from the text, such as "What he hath lost, noble Macbeth hath won" (Duncan).

Whose is this?
Tests if students can correctly identify the owner of various items, such as "a giant's robe" (Macbeth) or a lighted candle (Lady Macbeth).

Order! Order!
Requires students to correctly locate the Act for key events such as the death of Lady Macbeth (Act 5) or Macbeth's vision of daggers (Act 2).

Echoes
Provides examples of structural or thematic 'echoes' in the play and asks students to identify the missing element. For example the correct answer for "Macbeth has none; tries to kill them; they will steal his future" is 'Macbeth', and for "The thane of which place betrays Duncan twice" is 'Cawdor'.

Missing people and places
Tests whether students can correctly identify people and place – such as "Name Macbeth's father" (Sinel).

Who did this?
Asks students to identify a character from something that they did, such as "Was from his mother's womb untimly ripped" (Macduff), or "Wants to be 'unsexed'" (Lady Macbeth).

3.4.3.6 Tracker

The 'Tracker' locket allows students to explore the Text or an extensive range of commentary on the text. Both the text and the commentary sections are arranged sequentially from the start to the end of the play, with detailed Act and Scene notations throughout. Dynamic links between these two sections provide immediate connections between a particular part of the commentary and the text in the play to which this relates. A student studying a particular section of commentary on the play can, therefore, immediately switch at any time to seeing the Act, Scene and text to which this relates. In the 'Text' section the text itself in the software is colour coded throughout to show Act and Scene notation together with stage directions (in red), the text of the play itself (in black) and the many sections of the original text of the play which use archaic or confusing language or invoke references that are likely to be particularly confusing to a young person today (in purple). When the computer mouse is moved over each of these latter (purple) pieces of text a spoken commentary gives a modern translation and/or explanation of the reference that fits exactly the sense of the meaning at that point (see Figures 3.16 and 3.17). Although the author of the present study developed this technique in the absence of any theoretical

underpinning, recent research has demonstrated its efficacy in aiding comprehension of Shakespearean texts by learners with little prior experience and knowledge of them (Oksa et al, 2010).

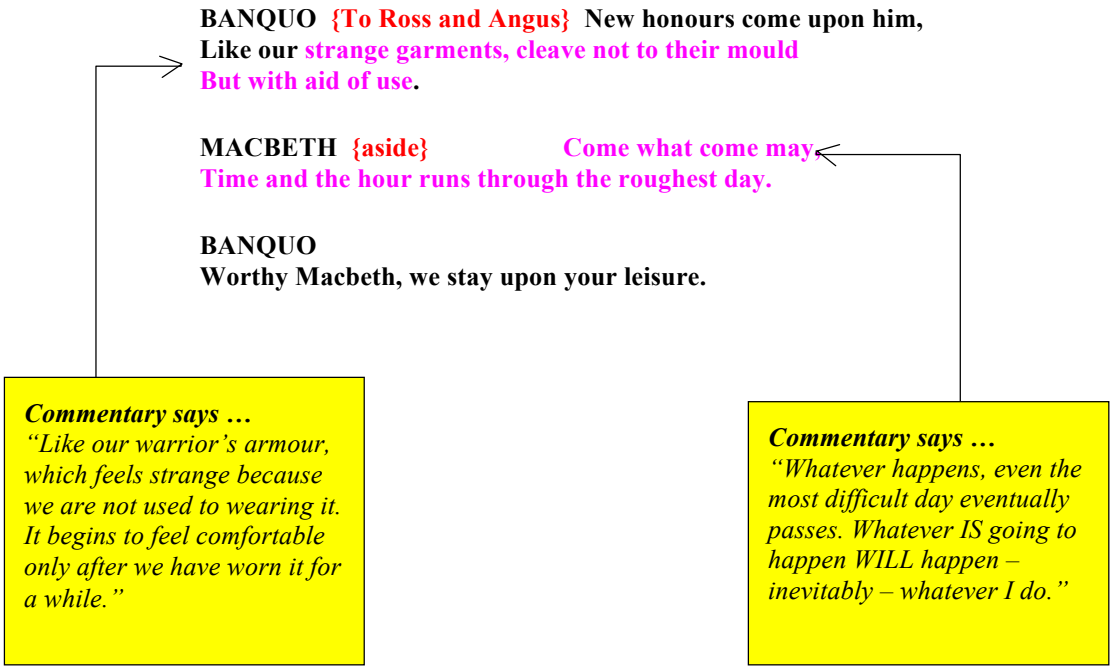


Figure 3.16 Tracker: Example layout for 'The Text' from Act 1 Scene 3 showing colour coding and the text (here in yellow boxes) for the spoken translation that is played when the computer mouse is placed over the purple text.

Act 1, scene 3, line 145
'Like our strange garments, cleave not to their mould …'

Commentary says …

It takes time to feel comfortable in new clothes, suggests Banquo. Consider the effect that the 'borrowed robes' have on Macbeth.

Figure 3.17 Tracker: Example of colour coding and the spoken translation that is played when the computer mouse is placed over the purple text.

3.4.3.7 Internet and Exit

The 'Internet' and 'Exit' lockets provide connection to the internet and close down the software, respectively. Earlier versions of the Windows software permitted internet access which, when cancelled, returned the user to the software package but occasionally using this feature with contemporary versions of Windows - whilst providing internet access as requested - may also cause the software to close.

3.5 Rationale – sampling strategy

This study began engaging with schools in the academic year starting in September 2004 and its methodology was developed in light of findings from relevant literature and from personal knowledge of teacher practice in the relevant subject area based on established relationships with schools in the region, personal experience of and reflection upon teaching in the subject area of English Literature for public examination and many years of classroom observation of teachers across a range of subjects.

In order to test the usefulness of the multimedia software that I had developed I wished to find a number of schools to conduct the two studies above. These schools needed to have students studying English Literature for GCSE examinations and be broadly comparable in other regards so that I might obtain a large but reasonably comparable sample of students. These schools also needed to have experience of using learning styles so that it would be possible to use their teachers and pupils for an examination of research question 2(a):

> Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

Equally, it would be helpful if I could select schools with identical experiences of using multimedia software, so that results from different schools or classes were not unduly affected by significant differences in prior experience with such resources. For the same kinds of reason it was important to select schools that were not too dissimilar in other regards, such as school size, their results for external audits of the quality of provision, the numbers of children receiving free school means and so on. Although it was impossible that identical schools

could be found and used in the study, it was important to try to create a sample that was reasonably homogenous, insofar as that was possible.

From the group of secondary schools used by a university in the North-East of England for placing trainee teachers during the school-based phases of their program, nineteen had recently been subject to government (Ofsted) inspections which in their resulting reports identified them as 'good' or 'outstanding'. The designations 'good' 'outstanding' by government inspectors carry significant currency within the UK; they are widely used (if contentious) government-endorsed judgments of the quality of educational provision and student performance which lead to associated benefits, including less intrusive inspection in the future. Inspection reports are published online, so praiseworthy inspections are useful to schools in promotional publicity, such as when seeking to recruit the most able and skilled faculty and also to parents when selecting the school they wish their children to attend. As the level of a state school's funding is closely linked to the number of pupils on its roll, increased competition for places at those which are perceived to be most successful ensures that such schools receive maximum income and acquire high status within their community. Inspection judgments are also referenced by the internet search engines of estate agents and have a strong influence on the prices that can be commanded for residential property closest to schools judged to be very successful. There is a powerful incentive, therefore, for schools and individual teachers to strive for positive outcomes from government inspections.

Within the group of comparable schools identified using this measure, a subset had in common that in their reports their inspection teams had noted that faculty were highly skilled at identifying students' individual learning needs and in meeting them with a range of different, effective, individually targeted teaching and learning resources and strategies. Within this group, four schools were more similar, despite serving communities providing student intakes of differing average levels of ability (Table 3.1). When discussing the possibility of the schools joining the research project with the Head Teacher and English Department staff it became clear that whilst they had well established English faculty, these teachers made relatively limited use of information technology in their approaches to learning and teaching. Technology use by the English faculty in each of these schools was largely confined to the use of Microsoft Office applications for word processing (e.g. for the production of student

assignments) and for information retrieval, where teachers would access syllabus information from government websites or where, under their direction, students would print lesson support material (e.g. worksheets) from online repositories. None of the English departments in these schools made use of other computer resources or multimedia applications to support the learning of students or the teaching of faculty staff.

School	Rating	Status*	Gender	Roll	VIth	FSM	SEN	Intake
1	Outstanding	11-18	Mixed	1334	135	Above average	Average	Well below average
2	Good	11-16 Language College (CE)	Mixed	1257	-	Above average	Average	Above average
3	Outstanding	11-18 Technology College (VA)	Girls	1300+	266	Above average	Below average	Above average
4	Good	11-18 Technology College	Mixed	1186	193	Above average	Average	Average

Table 3.1 Characteristics of the four schools, where *School* = school identifier; *Rating* = conclusion from most recent Ofsted inspection about educational standards (current at September 2008), teaching and learning and overall pupil achievement (especially at GCSE); *Status* = legal status of school; *Gender* = gender of pupils; *Roll* = total roll; *VIth* = number of roll in sixth form; *FSM* = proportion of pupils entitled to free school meals; *SEN* = proportion of pupils with special educational needs; and *Intake* = typical attainment level of pupils entering the school (the latter three items expressed in comparison to national averages).

* CE = Church of England; VA = Voluntary Aided (Roman Catholic).

Inspectors noted in each school that teachers knew and taught their pupils well, had high expectations of them, matched classroom activity well to their needs, succeeded in having pupils make effective use of a wide range of research skills, were adventurous and imaginative in their teaching, and used a variety of teaching and learning styles effectively. Inspectors also commented that achievement in external examinations was good and that teachers knew how to match their teaching styles and learning materials effectively to pupils' different requirements.

These schools had been judged to provide excellent teaching and learning opportunities for students and had between them made use of several instruments designed to assess learning styles. Their inspection reports spoke favourably of their use of measures of learning styles to inform pedagogy and

commented that such approaches were a key element in their success at matching instruction to individual students. There was therefore a high level of professional and government-approved public support for the effectiveness with which these schools used learning styles to sustain high levels of effectiveness and individualised learning. This was important for the present study for two reasons: it strengthened the comparability of the schools that were involved; and it provided a resource of teachers who were experienced in measuring and using learning styles. This latter point meant that a more informed discussion of the results of the study, especially with regard to the use of learning styles, was possible with practitioners.

Participants in these four schools were divided into those who replaced some of their normal English lessons with sessions where they used multimedia (the experimental group) and those having 'normal' (non-multimedia) lessons (the control group); in School One, each of these groups consisted of 133 students, in School Two there were 100 students, in School Three there were 102 students, and in School Four there were 59 students (Table 3.2).

		Sex		Groups		Total
		M	F	Experimental	Control	
School	1	128	138	133	133	266
	2	98	102	100	100	200
	3	0	204	102	102	204
	4	55	63	59	59	118
Total		281	507	394	394	788

Table 3.2: Composition of sample (M=male, F=female).

Existing teaching groups in the four schools were used to create a more natural (ecologically valid) teaching and learning setting for the half-term intervention than the strictly randomised groups that might feature in a fully experimental study; this also eased school timetabling difficulties. The study also adopted a quasi-experimental design, with equal numbers of experimental and control groups (classes) for each teacher. Only the experimental groups were used to explore the outputs from the LSQ and the LSI-2, as the main purpose of this part of the study was to establish whether these instruments gave valid and reliable outputs in this particular kind of educational context and the experimental groups on their own gave a sufficiently large sample size to allow the intended data analysis (factor analysis) to be conducted. However, both the experimental

and control groups were used to explore the effect on learning of multimedia use because it was important to have two separate but similar groups with which to compare the effects of using (or not using) the multimedia resource in teaching the General Certificate in Secondary Education (GCSE) English Literature syllabus (see AQA, 2008, 2009, 2011; Edexcel, 2009a, 2010; QCDA, 2011).

3.5.1 Controls

As far as was possible, equal numbers of teaching groups and participants came from a number of existing classes in these schools, such that for any given subject teacher the same number of classes they taught appeared in the multimedia (experimental) and non-multimedia (control) group (Table 3.2).

It is generally not possible to create full experimental conditions in field studies such as that reported here, mainly for practical reasons of securing the willing participation of schools and also for ethical reasons, such as if considering administering an intervention thought to be unhelpful or of no benefit. However, a number of elements could be controlled reasonably well: experimental and control groups were matched for age-range and performance to date to give a representation of 'more able' and 'less able' students (as determined by the school's assessment and 'setting' arrangements) and as far as possible for numbers of males and females (except in School 3, which was all-female).

Within these constraints classes were randomly selected for participation as far as possible (within the limits of the number of classes available in each school). Classes from each school were involved in the study for the same number of weeks (generally a complete half-term), for whole lessons at a time (around one hour in the case of each school) and in terms of the examination being studied for and the syllabus being followed. Teachers were all established in their school and very (but not identically) experienced in teaching their subject to the relevant examination level (GCSE) and were asked to make no changes to their existing teaching strategies and the resources they customarily used, except for the occasions when the experimental groups used multimedia resources. No controls were imposed for teacher gender, differences in teacher attitude towards multimedia or familiarity with computer use and comparative measures of teaching strategy when using or not using multimedia were not undertaken.

As was discussed in the literature review, although reasonable internal consistency might be expected of an individual's scores on an instrument such as the LSI-2, its context dependency (Kolb, 1984) and age sensitivity (Cavanagh & Coffin, 1994) as also that of the LSQ, might introduce variability when no context is specified. To minimise the effects of this the methodology of the present study gathered data from students from English Literature GCSE lessons only, by completing data collection during one class period in this subject with their normal teacher present and by asking all participants to focus only on the learning with regard to that subject and context when making their responses. Students completed the Kolb LSI-2 (Appendix 1) and the Honey and Mumford LSQ (Appendix 2) consecutively as part of a normal Year 11 GCSE English Literature lesson and a total of 394 complete sets of matched data were obtained for each subject (Table 3.3).

School	Male	Female	Totals
A	64	69	133
B	49	51	100
C	0	102	102
D	28	31	59
Totals	141	253	394

Table 3.3 Nature and numbers of students in sample for the present study.

This approach was intended to ensure low discontinuity of experience and to minimise any variability in the learning context that subjects may have visualised during testing, which has previously been identified as a potential contributor to problems of validity (Willcoxon & Prosser, 1996; Wierstra & De Jong, 2002).

Additionally, to mitigate the possible effect of a response bias in the LSI, the order of the alternatives was adjusted so that each of the four modes appeared with equal frequency within the first, second, third or fourth position in the questionnaire. This was intended to prevent the instrument producing a positional response set in the data, which has previously been identified as a potential weakness of the LSI in several studies (Atkinson, 1988; Veres, et al, 1987, 1991; Cornwell, Manfredo & Dunlap, 1991; Wierstra and De Jong, 2002) and removing the patterned order of alternatives has been found to much improve its reliability (Veres, Sims & Locklear, 1991).

3.6 Data collection and analysis procedures – quantitative and qualitative

The schools featured in this study had in common substantial experience with and reliance on both the Learning Styles Inventory (LSI-2) developed by Kolb (1995) and the Learning Styles Questionnaire (LSQ) produced by Honey and Mumford (1992), which were chosen as the focus for the present study. A sample of 394 Key Stage 4 (K11-K13) students in these schools were selected (the experimental group) and complete sets of matched data were obtained for each subject (141 boys, 253 girls) from the LSI-2 and the LSQ from the 16 classes taught by 18 different subject specialist English teachers in the selected schools.

The four schools between them adopted a variety of approaches and instruments that claimed to indicate or measure the learning styles of pupils. These schools required faculty to use the data gathered from such instruments (such as Honey and Mumford's LSQ and Kolb's LSI-2) to inform classroom pedagogy or to develop regimes of skills-teaching and assessment. Each school had at least one member of staff with special responsibility for overseeing this work and for training other teachers in the use of these instruments. These individuals had often been on special learning styles training courses and were highly promoted within their school - occasionally their responsibility for learning styles was subsumed under their work as a head of department, sometimes it was independent of subject responsibility and in a few cases it was a significant part of the work of one of the school's deputy heads. These schools continued to invest substantial resources in the use of learning styles.

3.7 Limitations of the research, validity, reliability and ethics

3.7.1 Limitations of research using surveys

One of the main problems with subjective (i.e. self-report) survey instruments in general is attributable to what Argyris described as the difference between *espoused theory* and *theory in use* (Argyris, 1976), that is, the difference to be found between what individuals say they do and what they actually do. Learners may identify a particular approach to, or difficulty with, learning (for example) as the one they most frequently use or experience, but unless this is verified experimentally or by other means we are unable to determine the accuracy of

such reports, and a learner may well employ entirely different strategies (or experience entirely different difficulties) in practice from those they consistently report in good faith on questionnaires or during interview. This problematic limitation of instruments employing self-reporting (see Veenman, Prins and Verheij, 2003) has also been identified with regard to the use of instruments proposed for measuring cognitive load. This becomes particularly problematic when cognitive load varies as a result of the learner's changing framework of reference and increased schema acquisition in response to the course of learning (i.e. as learner expertise increases) because the difficulties that are perceived by the learner and the associated degree of helpfulness of particular resources may be continuously changing as learning proceeds (Schotz and Kürschner, 2007). The use of measures of ease-of-learning for each resource used in the field experiment is argued here to be sufficient to reduce the ambiguity of the self-report instrumentation used and to address many of the concerns outlined above.

3.7.2 Limitations of research using (quasi-)experimental designs

The quasi-experimental approach adopted for exploring the Cognitive Load aspect of the present study offset the disadvantages of not using a full experimental (scientific, controlled) design through the use of a more naturalistic and ecologically valid approach. As a fully experimental approach is rarely feasible when engaging with schools, a more opportunistic and 'realistic' approach to methodology is often the only viable alternative, but this has the benefit that because it uses more 'natural' settings, groups and structures (in the present case these are schools, classes, normal lessons) it can therefore lend greater credence to findings in the eyes of those involved.

However, even quasi-experimental approaches by their nature make conscious and deliberate choices about the selection of data – and therefore of the exclusion of other data. In the present study these choices applied to the selection of a particular theoretical perspective (Cognitive Load Theory) for seeking an understanding of the interaction of individual pupils and resources in the development of learning and understanding. These choices also extended to the development and use of a particular instrument (the questionnaire test/re-test) to measure learning and understanding over a fixed period of time during which the experiments ran. These features of the intervention contributed to an

informed view of the area of study but equally may also have limited the understanding to be gained by narrowing the focus of scrutiny to a small number of concepts, theoretical constructs and outputs that were applied during approximately half a term (although this is quite a long period of study when compared to much of the other work that has been done in the field).

Equally, because it can be impractical to study many things at the same time in a quasi-experimental setting, some data were excluded from the study. For example, outputs from only the two main learning styles instruments used in the schools were examined and schools using alternative instrumentation were not involved in the study. Similarly, only schools with English faculty making relatively limited use of multimedia were involved and although this may have helped to remove extraneous influences due to prior learning and experience with multimedia, it may also inadvertently have invoked a Hawthorne effect despite the precautions taken to minimise this.

Further, no controls were imposed for teacher gender, age, differences in teacher attitude towards multimedia or familiarity with computer use and comparative measures of teaching strategy when using or not using multimedia were not undertaken. Data used in the study also did not include the eventual GCSE performance by the students involved. Such data and variables may contribute important information that is relevant to the area of the present study and would therefore benefit from further investigation and such studies could also usefully widen the range of contexts to different schools and regions to establish the extent to which the finding from the present study may be generalised.

3.7.3 Considerations of mixed methods research

The unhelpful polarization of research into confrontational positions regarding the relative value of quantitative or qualitative approaches has been argued against by a number of scholars (Ercikan & Roth, 2006; Denscombe, 2008) and some have even argued for replacing these terms with less contentious alternatives such as ‘confirmatory’ and ‘exploratory’, respectively (Onwuegbuzie & Leech, 2005). The present study made use of both quantitative (confirmatory) and qualitative (exploratory) methodologies both on grounds of appropriateness and pragmatism and because it was felt that each had a valuable contribution to

make towards a more rounded understanding of how pupils' experiences of learning and teaching in school classrooms relates to the pedagogical approaches adopted by their teachers, the political and professional tensions that operate within schools (as well as those that are imposed upon them) and the contribution to learning that may be made by multimedia resources.

The use of professional experience when applied to developing artefacts that are designed to facilitate learning can be valuable in creating 'what works' solutions and overcoming perceived barriers to learning. Equally, the use of statistical analysis to illuminate relationships within data is valuable for scrutinising practice built upon assumptions about 'what works' and educational theory alike and is also important for testing instruments purporting to give meaningful information about the learning of individuals. Bridging these realms of pragmatism and analysis, of research and of practice, the use of teachers' perspectives can contextualise and inform data about learning and instruments used to measure it, so as to aid our understanding of the nuances and richness of behaviour within teaching and learning settings in schools. Similarly useful is the application of theory derived from neuroscience to the use of learning resources developed from professional practice and the correlation of output from instruments based on Cognitive Load Theory with measures of actual gains in learning from using these resources. Such mixed research methodologies can illuminate both theory and practice and provide valuable indications of how each may gain benefit and progress understanding from this interaction.

3.7.4 Ethical considerations

All participating schools consulted the parents of pupils who might potentially be involved in the study and obtained consent for each pupil's participation in the project. The participation of the schools was secured by each Head Teacher with the consent of the teachers who were involved and was also approved by the school's Governing Body. Participation in the study was not compulsory but all schools and students who were approached agreed to participate. Documentation relevant to the ethical process (including securing approvals) can be found in Appendix 9.

Questionnaire data that was collected included student name, class and school in order to facilitate analysis through correlation with test-retest data and alignment with other data collected (for example on pupil ratings for ease of learning with different resources) but all published information has been anonymised, as negotiated and agreed with the schools. This arrangement reassured participants and their parents and was believed by the schools to contribute to the high level of participation.

Examples of incomplete data sets - resulting for example from pupil absence for the retest or from students leaving the school to move to another area – were eliminated from the study, as were the small number (13) of 'spoilt' questionnaires.

3.8 Summary

The methodology for this study makes necessary use of mixed methods including questionnaires, interviews and discussion, statistical and content data analysis and triangulation between these to respond to the research questions and provide the necessary evidence, analysis and rich description required for an deep exploration of the research questions.

Survey instruments are used to elicit individual responses to questionnaires that permit the testing of two theoretically complementary approaches to describing individual learning styles for validity and reliability in the context of GCSE study of English Literature. A third, specially designed, instrument is used to obtain individual student ratings of different classroom resources and a purpose built multimedia application when they were asked to score each of these to show how easy they found each one for helping them with their learning. These measures are used in conjunction with a fourth instrument developed to test relevant student knowledge and understanding to test the contribution of Cognitive Load Theory to the effective design of educational resources. A quasi-experimental research design is used to explore the effect of using a range of different resources on individual learning and understanding of *Macbeth*, as measured using a test designed with the help of the teachers in the four schools.

This chapter has discussed the conceptual frameworks underpinning the methodology and instruments used to address the second research question and its sub-questions:

2. Can multimedia software enhance student achievement at GCSE level?
    a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
    b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

The relationship to the overall thesis of the investigation of learning styles, Cognitive Load theory and multimedia has been set out and the methodology for each described, including the use of the data collection instruments applied in relation to each of these. The rationale has been given for first conducting the study of learning styles with a limited sample before proceeding to the study of the relationship between multimedia use, gains in knowledge and understanding and Cognitive Load Theory with the full sample. The design, construction and operation of the multimedia software has been described, along with the other learning and teaching resources used. The rationale for the sampling strategy and choice of schools has been given along with details of the sample itself and the controls applied within the study. Qualitative and quantitative data collection procedures have been described and the limitations of the research set out, including issues of validity, reliability and ethics.

The next Chapter (Chapter 4) describes a study to address research question 2(a):

> Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

by exploring the contribution of learning styles theory to our understanding of the relationship between the learner and instructional content. Kolb's LSI-2 and Honey and Mumford's LSQ are tested with the experimental groups in the four schools and the chapter discusses whether these are able to usefully identify the individual learning styles for the students. The actual and perceived value to

teachers and schools of these instruments and their measures is explored. The usefulness of and implications for learning styles for the design and use of multimedia software is then discussed.

Following Chapter 4, Chapter 5 reports a study that addresses research question 2(b):

> Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

and reports the experimental study conducted in the four schools using both the control and experimental groups of students to explore the relationship between the format of instructional material, the use of multimedia and individual learning.

Chapter 4 – Data analysis: Learning Styles

4.1 Introduction

The literature on the educational uses of ICT identifies the use of learning styles as one way in which technology may be able to better support individual learning in classroom contexts (Chapter 2). The assumption in much of the literature on learning styles and computer use is that because it is possible to present different users with different kinds of subject content in a variety of formats, computer software may be able to offer individual students learning materials that are better suited to their preferred learning style than is possible in traditional classroom settings and in settings that do not make use of computers. The proposition underlying this argument is usually that learning styles are relatively stable personal dispositions rather than being dynamic responses to changing learning environments – i.e. that they are 'trait-like' rather than 'state-like' (Ruble & Stout,1991). In the former case, knowledge of an individual's learning style would enable the student or their teacher to 'match' content (or more usually the format of instructional content) to suit the given style of the learner in line with this trait. Kolb (1984) and Honey and Mumford (1992) have made significant contributions to arguments proposing the use of learning styles as relatively stable individual dispositions and to developing individual measures of learning style. Both of their approaches are based on Kolb's iterative stages of learning (Chapter 2; Figure 2.1) and use similar constructs derived from this in their respective theoretical models, but different nomenclature and instruments to measure these; Kolb's LSI-2 (1985) and Honey and Mumford's LSQ (1992).

Using the methodology set out in Chapter 3, the present Chapter sets out an application of the above instruments to answer the research question 2(a):

> Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

To answer this question within the context of the present study the instruments developed by Kolb and Honey and Mumford for the measuring of learning styles are tested to find out whether they offer valid and reliable outputs. The implications of the outputs of these instruments for individualised instruction and multimedia are considered, along with their actual and perceived value to

teachers and schools. The usefulness of learning styles for the design and use of multimedia software is discussed.

4.2 Sample

Four similar schools in the North East of England were involved in the larger study. Within these schools 18 established teachers of GCSE English Literature were involved together with a total of 788 students (281 males; 507 females). Within each school each teacher's classes were allocated into either the experimental or control group such that each of these groups contained a total 394 students. For the present stage of the study that is addressing research question 2(a) a subset of this larger sample was used. Complete sets of matched data were obtained for each participant in this subset (141 boys, 253 girls) from the LSI-2 and the LSQ from 16 classes taught by the 18 different subject specialist English teachers in the selected schools. The criteria for the sections of schools, teachers and students for the study are discussed more fully in the Methodology (Chapter 3; see also Tables 3.1 and 3.2).

4.3 Instrumentation

Students completed the Kolb LSI-2 (Appendix 1) and the Honey and Mumford LSQ (Appendix 2) consecutively as part of a normal Year 11 GCSE English Literature lesson. A total of 394 complete sets of matched data were obtained for each subject (Chapter 3; Table 3.3).

4.4 Results

In the discussion of Learning styles in the Literature Review (Chapter 2) the need to 'calibrate' the instrumentation used for measuring learning styles against the mean scores for a relevant population was discussed and the rationale for this set out. To summarise that discussion: calibration is used to calculate the intersection point of the relevant learning style axes when creating a graphical depiction of learning style and is important because the exact location of this point varies with the age and occupational role of the subjects with which the learning style instrumentation is being used. Honey and Mumford concur with Kolb that when using their instruments to measure learning styles, referencing an individual's scores to the relevant wider population mean in this

way is important. The scale means for the subset of students in the present part of the study were therefore used for analysing outputs from the LSQ to replace those from the (typically adult) reference groups used by Honey and Mumford and those from that used by Kolb for the LSI and to calculate the origins for graphical representation (Table 4.1).

Table 4.1 Mean scores, standard deviations and effect sizes (d) of population samples for the current sample subset compared to those from Honey and Mumford's reference data from 21,216 individuals (2007) and those for Kolb's reference group of 6,977.

	Current		Honey & Mumford				Current		Kolb		
Style	M	SD	M	SD	ES	Style	M	SD	M	SD	ES
Activist	10.58	4.14	9.7	3.7	0.22	Divergent (CE)	32.98	4.15	26.2	6.9	1.22
Reflector	9.37	4.19	13.7	3.7	-1.10	Assimilator (RO)	26.65	3.85	29.8	7.0	-0.58
Theorist	6.89	3.46	12.3	3.3	-1.60	Convergent (AC)	26.70	3.90	30.8	7.2	-0.74
Pragmatist	8.35	3.65	12.9	3.0	-1.37	Accommodator (AE)	33.67	4.37	33.1	6.5	0.11

When comparing the mean scores of the present sample from the LSI-2 and the LSQ with those used by Kolb and Honey and Mumford, it was found that the students had lower mean values for Reflector, Theorist and Pragmatist compared to Honey and Mumford norms, and were more Divergent but had lower scores on Assimilator and Convergent than the Kolb norms. According to the theoretical constructs underpinning these two instruments there is supposedly equivalence between Theorist (20.3% of the current sample) and Convergent (26.3%); Activist (17.1%) and Divergent (29.2%); Reflector (28.4%) and Assimilator (19.7%); and Pragmatist (34.2%) and Accommodator (24.7%) (see Chapter 2, Section 2.6 for a fuller discussion of this).

In his approach, when computing X and Y coordinates for graphical presentation, Kolb subtracts scores such that X represents each individual's score for *Active Experimentation* (AE) minus their score for *Reflective Observation* (RO) and Y represents their score for *Abstract Conceptualisation* (AC) minus their score for *Concrete Experience* (CE). The parallel computation for Honey and Mumford's LSQ data is to generate the X axis component by taking an individual's score for *Pragmatist* and deducting from it their score for *Reflector* and for the Y axis component to take their score for *Theorist* and

deduct from it their score for *Activist*. The scatter plots in Figures 4.1 and 4.2 are the result of this analysis for the present sample.

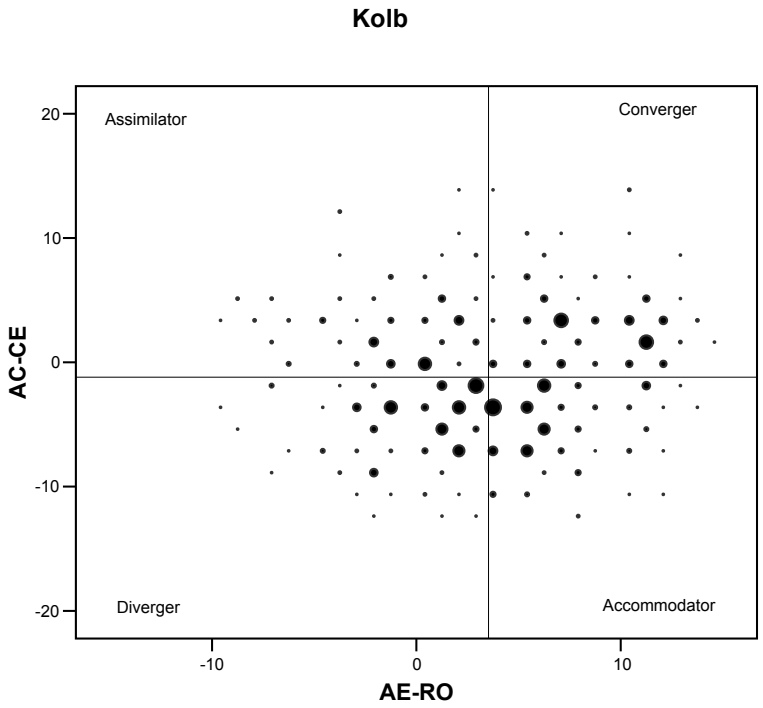


Figure 4.1 Scatter plot of student scores using Kolb's LS analysis.

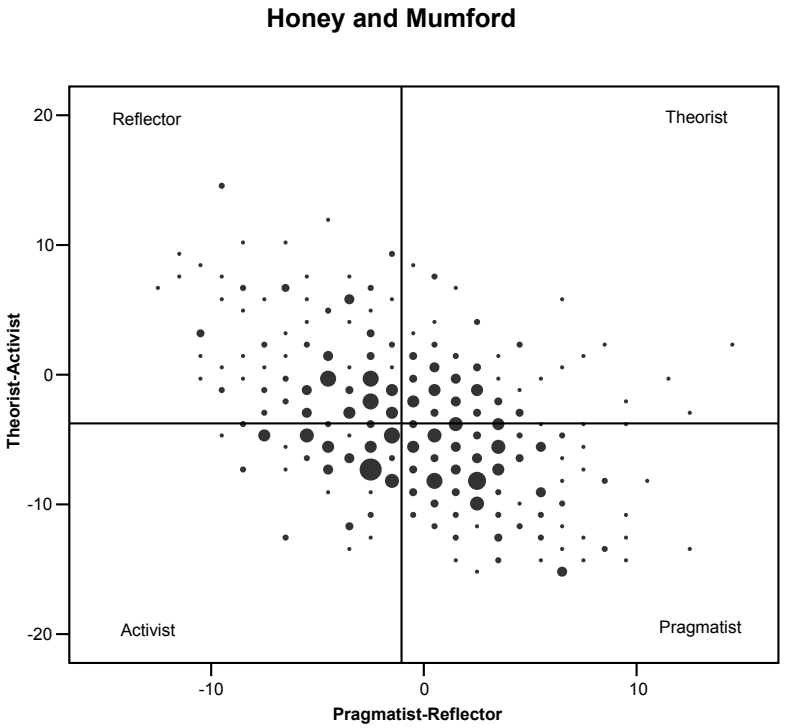


Figure 4.2 Scatter plot of student scores following Honey and Mumford's LS analysis.

A visual comparison of Figures 4.1 (Kolb's LSI) and 4.2 (Honey and Mumford's LSQ) shows that both the distribution and density of the resulting data are not similar, despite being for the same subjects. The overall distribution of individual subjects within the two graphical spaces is unmatched, as is that within each graph's equivalent sector, which according to their respective theoretical constructs should be identical. Further, the distribution and density of Kolb's *Assimilators* appears to the naked eye to be quite different to that of Honey and Mumford's *Reflectors* (to which it is an equivalent) and this lack of matching is repeated for the *Converger-Theorist*, *Diverger-Activist* and *Accommodator-Pragmatist* pairings.

A cross-tabulation between the assigning from the two instruments indicated some overlap (chi-square of 13.06, df=9, p<.014), but when the more appropriate measure was used that corrects for chance effects in this comparison there is clearly no common meaning across these measures (Cohen's Kappa = .071).

This lack of a relationship is also reflected in the very low correlations (r) between the corresponding scales and the equally low percentage of variance explained by them (in parentheses in the text which follows). The correlations between the supposed similar constructs are Divergent-Activist r = .047 (.2), Accommodator-Pragmatist r = .24 (5.9), Assimilator-Reflector r = -.02 (.02) and Convergent-Theorist r = .13 (1.8). Such figures indicate that these theoretically related scale elements associate mostly by chance even when correlations are statistically strongly significant (Table 4.2) and that element components therefore explain very little of the variation in individual student scores.

Teachers in all the schools in this study used both the LSI-2 and the LSQ and when asked about which they preferred reported that the choice of which one to use tended to depend heavily on which of the two instruments had the largest pile of blank questionnaire forms available in the store-room at the time of selection. Some schools and teachers therefore ended up using one or the other of these instruments more frequently than the other by chance but no records of use were kept by teachers and because the central stocks of blank questionnaire forms were replenished as supplies became low it was not

possible to establish the frequency of use from each school's central records. Whichever selection teachers made, the outputs from the instrument they chose were used to classify the learning styles of their students and were applied accordingly in their lesson planning and written reports as described in the Discussion section below (section 4.5). The different names of styles between the two instruments were not seen as important or problematic, because teachers reported that they used the general descriptors of the styles as their guide rather than just the single word titles, as the former were more useful (the relationship between these general descriptors is discussed in Chapter 2; Literature Review).

Teachers were therefore applying the LSI-2 and LSQ at the level of their theoretical constructs, rather than simply adopting and using the construct labels. However, in the light of the findings reported here, a teacher making a judgment about an individual's learning style could therefore place a student in quite different classifications (construct areas / learning styles) depending on which of these two instruments was used (Figures 4.2 and 4.3). This is also illustrated in the different percentages of respondents extracted by the two instruments in the diagonal compared to the off-diagonals shown in Figure 4.4 where the percentage figures in the diagonal (in bold type) should, if the instruments are congruent in their findings, be much larger than the off-diagonals but this is clearly not the case (Table 4.3).

Table 4.2 Correlations (r) between the LSQ and LSI-2 outputs. Theoretical equivalences (the diagonal) shown in bold type.

	LSQ (Honey & Mumford)			
LSI-2 (Kolb)	Activist	Pragmatist	Reflector	Theorist
Divergent	**.047**	-.141(**)	.004	-.080
Accommodator	.173(**)	**.243**(**)	-.033	.063
Assimilator	-.170(**)	-.183(**)	**-.015**	-.121(*)
Convergent	-.077	.057	.047	**.133**(**)

** Significant at the 0.01 level.
* Significant at the 0.05 level.

Table 4.3 Percentages of respondents extracted for the Kolb's LSI-2 (down) and Honey & Mumford's LSQ (across). Theoretical equivalences (the diagonal) shown in bolt type.

	Activist	Pragmatist	Reflector	Theorist
Divergent	**38**%	28%	32%	19%
Accommodator	22%	**27**%	26%	22%
Assimilator	20%	18%	**21%**	19%
Convergent	20%	27%	20%	**39**%

The subscales of the LSI-2 also appear to have poor estimates of reliability, producing coefficient alpha values from .28 (AC), .31 (RO), .40 (CE) or .40 (AE), whereas those for the LSQ appeared to be better: Theorist .71, Pragmatist, .72, Activist, .78, Reflector, .79. Together these results suggest that the LSI is the weaker of the two instruments and provides outputs that are little better than using random numbers (see Thissen & Wainer, 2001).

4.4.1 Factor analysis

Exploratory principal component factor analysis was used to explore the underlying constructs within the data for the LSI and LSQ using the eigenvalue ≥ 1 rule, scree plot tests, the number of salient variables to give loadings of at least ± 0.40 on components and by using orthogonal (varimax) and oblique (oblimin) factor rotations to determine the most meaningful structures. The theoretical structure of Kolb's model, adopted by Honey and Mumford, proposes that the four LSI learning modes, or LSQ elements, represent independent stages or preferences and therefore an orthogonal rotation extracting four factors was expected to produce the clearest and least theoretically ambiguous solution for the two instruments.

However, in line with the confusing findings from visual inspection discussed above, initial analyses showed a large number of items that did not load strongly or uniquely on the four expected factors. Further, no matter what was done to eliminate from the analysis items which seemed not to load clearly onto any one factor, the items on Reflector and Theorist for Honey and Mumford's LSQ refused to separate into two distinct factors (Figure 4.3).

Kolb

LSI item		Component			
		1	2	3	4
CE (feeling) Divergent	1	.575			
	2	.550			
	3	.744			
	5		-.699		
	7		-.412		
	8	.484			
RO (watching) Assimilator	2				-.624
	5	.528			
	6			.478	
	7	.441			
	9				-.582
AC (thinking) Convergent	2	-.529			
	3			.503	
	5		.592		
	6				-.414
	8		.534		
	9				.490
AE (doing) Accommodator	1	-.349			
	2			-.490	
	3	-.499			
	4		.546		
	6			-.612	
	8	-.461			
	9		.473		
	10			-.493	

Honey and Mumford

LSQ item		Component			
		1	2	3	4
Activist	2		.417		
	4		.472		
	23	.403			
	32			.422	
	34		.439		
	45		.487		
	48			.564	
	58			.672	
	72			.455	
	74		.518		
Reflector	7	.433			
	13	.416			
	16	.553			
	25	.504			
	29	.536			
	31	.452			
	41	.433			
	46	.553			
	60	.557			
	62			-.642	
	66	.599			
	67			-.647	
	76	.476			
Theorist	1	.436			
	3	.473			
	57	.503			
	63	.432			
	68				.431
	75	.469			
	77	.407			
	78				.468
Pragmatist	21			.406	
	35	.554			
	44	.421			
	49	.431			
	56	.414			
	59				.540
	65				.420
	69		.506		
	80				.483

Figure 4.3 Component matrix for Kolb's LSI and for the Honey and Mumford LSQ using Principal Component Analysis with Varimax rotation. CE = Concrete Experience; RO = Reflective Observation; AC = Abstract Conceptualisation; and AE = Active Experimentation. Absolute values (correlations) less than 0.40 are not shown.

The best subset of items for the LSQ were retained and a restricted factor (over-identified) model was specified (Figure 4.4) using AMOS (Arbuckle, 2003). The fit of the four factors was found to be acceptable (chi square 796, df = 489; RMSEA = .040). However, the correlation between the Reflector and Theorist items remained very high (r=.87), strongly suggesting that these are measuring the same (or very similar) things twice rather than two distinct factors. The estimates of reliability are also barely adequate, even for this best subset (Activist .62; Reflector .78; Theorist .66; Pragmatist .54).

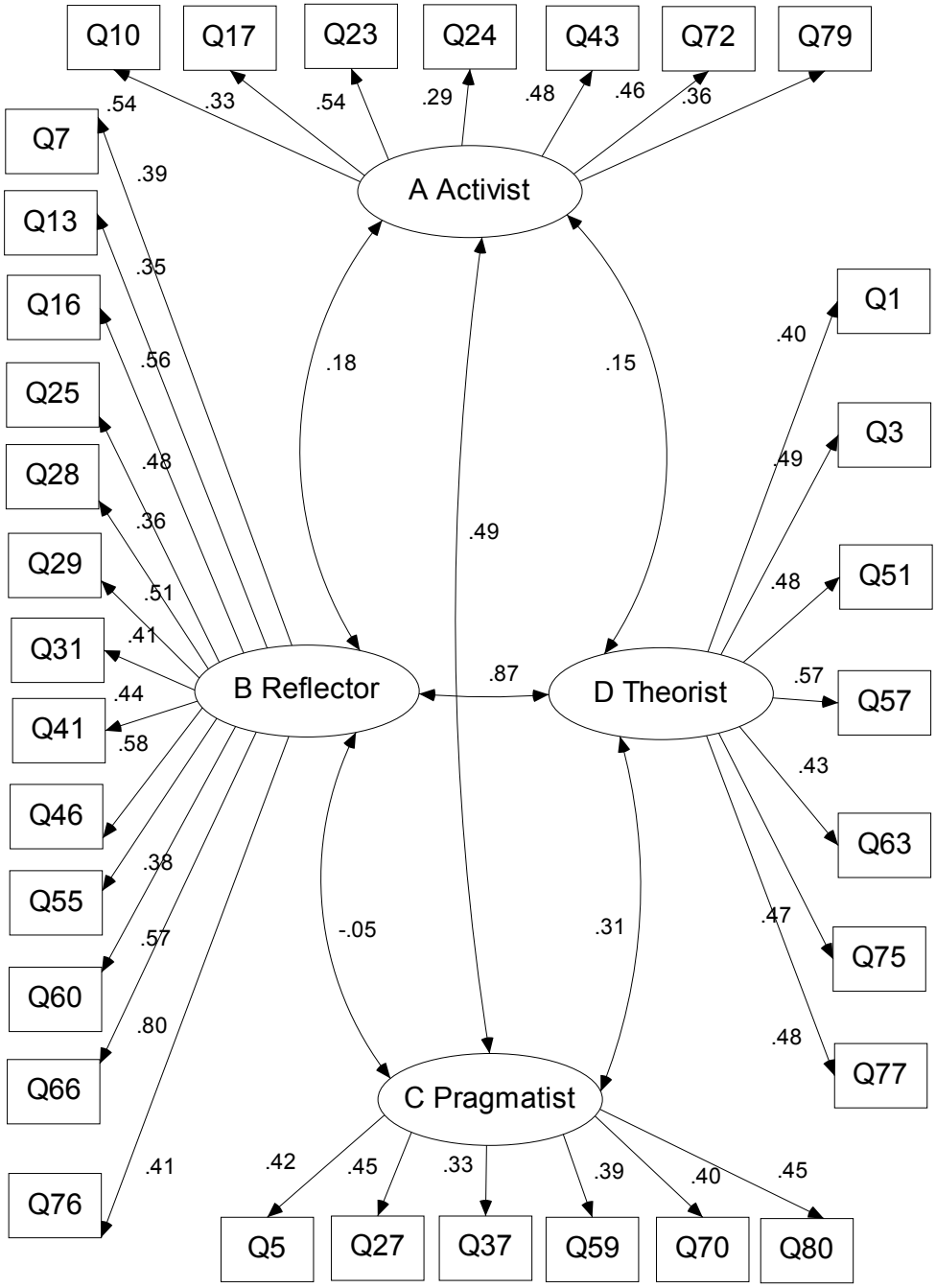


Figure 4.4 Restricted factor model for the LSQ.

4.5 Discussion

The first two factors in the LSI-2 (Figure 4.3) may be interpreted as hinting at dimensions of 'watching/feeling' versus 'thinking', but the interpretation is only weakly supported by the analysis presented here and is compromised by incoherent expression within the variables. Together all four factors explain only 26.6% of the variance. A two factor extraction, following the approach of Wierstra & de Jong (2002, p. 435) failed to replicate their findings for their

proposed factors for ‘thinking versus doing’ and ‘feeling versus watching’ and explained little of the variance (16.3%). These results of both the four and two component analyses are clearly at variance with the expectations of Kolb’s theory.

The theoretical model for the LSQ also requires each extracted component to load strongly from its associated twenty questionnaire items. Only half of items were, however, found to match any construct to a significant degree and many of the items within each theoretically associated group of questionnaire questions did not load uniquely against any single extracted factor; *Reflector* loaded into its strongest component from 65% of theoretically relevant questionnaire items; *Activist* from 50%; *Pragmatist* from 45% and *Theorist* from 40% (Figure 4.3). The extracted factors between them also explained relatively little of the total variance for either instrument (LSQ = 24.3%, LSI-2 = 26.6%), items did not load for either instrument on factors as predicted and no coherent match was identified between items and the theoretical constructs in the models.

The finding presented here suggest that the teachers might be justified in having a little more confidence in the LSQ than in the LSI-2, but the factor structure shows there is still much cause for concern about the LSQ scale. The estimates of reliability for the best subset of items are still too low and the correlation between some of the factors is too high, particularly for Reflector and Theorist. Therefore despite using similar descriptors for their respective classifications, Kolb’s LSI-2 and Honey and Mumford’s LSQ did not create similar classifications. No systematic or statistically significant correlation between the outputs from these instruments was found, and there is a lack of construct validity for either instrument. There findings here replicate those of Sims, Veres and Shake (1989), who after examining the construct validity and convergence of Kolb’s LSI-2 and the LSQ with 279 students in two universities in south-eastern USA found little supporting evidence and questioned whether either had effectively operationalised their constructs (cf., Goldstein & Bokoros, 1992).

There is therefore no evidence from this part of the study that should allow the teachers in the four schools to feel confident that using these two instruments will be of benefit to them or their students regarding the use of learning styles when learning or teaching English in the secondary curriculum. It was also clear

that it would not be possible to draw on these particular findings about learning styles to reflect meaningfully on, or understand more fully, much earlier observations of student behaviour when using the *Zork!* software, or to make use of the LSI-2 or LSQ when progressing to the next stage of the study using the English Literature multimedia software.

However, it became clear in the follow-up and de-briefing sessions that were conducted with teachers after this stage in the study that although they accepted the findings about the questionable value of the LSI-2 and the LSQ and agreed that its use for the next stage of the study using the multimedia software was therefore not advisable, the use of learning styles in their routine practice was perceived to have tactical value in a direction that had not been anticipated in the original design of the study; defending teachers' own professional image, identity and authority within the classroom.

The extended de-briefing discussions and follow-up interviews with teachers in the schools involved were conducted both to outline and explore the wider research background to the LSQ and LSI-2 discussed above. It was noteworthy during these group and individual discussions how many faculty in all of the schools remained unperturbed by the results from this stage in the study. Teachers felt these findings would have no effect on the continued use of one or both of the LSI-2 and LSQ in future, either by themselves or by teachers in other schools they knew of that used them. A number of reasons were advanced for this, which between them highlight the complex dynamics operating upon teacher pedagogy and instructional management within these classrooms and schools and the important influence on these of teachers' perceptions about how their own school management hierarchy and external agencies come to make judgments about the professional competence and performance of teachers. Interviews revealed that teachers' reflections were informed by a number of concerns, perceived pressures and considerations which it was possible to differentiate from interview content analysis into six vectors operating semi-independently: face validity; inspection; accountability; school policy; initial training; and pedagogy.

The first perspective upon which these teachers drew heavily was that of *face validity*. Most conceded that they had been strongly influenced by the perceived face validity of the learning style instruments, which seemed to them to accord

with the ‘common sense’ premise that if children do not all learn in the same way, teachers cannot teach them all in the same way (Table 4.4).

Table 4.4 Extract of post-intervention teacher reflection – Face Validity.

Everybody acknowledges that children are all different and there is plenty of research that emphasises why and how we should differentiate practice. So I don’t see why we shouldn’t be using learning styles as part of classroom activity. *Teacher ‘A’.*
Children are still developing their approaches to learning and it’s likely that these haven’t settled down into a fixed approach yet. *Teacher ‘C’.*
Maybe these instruments aren’t very good at measuring learning style, or perhaps they are only useful with adults or in industry, but that doesn’t mean that the principles behind them are not useful. *Teacher ‘D’.*
The research results do concern me, but I know that differentiating content and approach in my classroom makes children learn more effectively, even if only because they are more motivated, so these results don’t change that. *Teacher ‘G’.*

Several teachers variously expressed another common view about the originators of the LSI-2, the LSQ and similar other instruments of which they had experience: “these people are academics who have websites and they’re backed by impressive publishing companies – if they were no good they would have gone out of business years ago”. This tendency to ascribe value to well-known or enthusiastically promoted educational approaches of dubious or unknown warranty has been commented on elsewhere, where it has been concluded that it increasingly trivialises the complexity of learning (Sharp et al, 2008).

A second theme to emerge from teachers’ interviews was focussed on the implications for *inspection* (Table 4.5). Teachers pointed out that the strong performance of each of their schools in their recent inspection had actually increased the likelihood that they would continue to use the LSI-2 and LSQ, irrespective of any identified reservations or failings. This was because institutions judged to be ‘excellent schools’ might feel under particular pressure to demonstrate to parents and government that they embraced the use of measures of individual difference, in line with government policy encouraging this philosophy, and to show that these were being employed in the classroom. It seemed to several of the teachers interviewed that it would be very difficult for their school to defend their award of excellence whilst taking action that seemed

to reject students' individual differences. For most parents, governors on the school board and also for some school managers and many inspectors, the use of learning styles was perceived by teachers to be an attractive and easily absorbed message that individual student differences were being effectively accommodated into their practice. The pressure to use learning styles was perceived to be further increased by a good inspection report because it strengthened the school's need to proactively develop further its own evidence base in order to maintain the school's favoured position and minimise the possibility of a more rigorous future inspection. The teachers in this study were united in their view that school inspectors always tended to look favourably on the use of learning styles, that inspectors were impressed by their use and saw this as evidence of a seemingly rigorous approach to measuring and employing individualised student learning.

However, the approach adopted by the government for identifying 'highly successful' schools was regarded as deeply flawed by many of these teachers, despite the favourable reports that had been returned on them and their institutions. Teachers ascribed their lack of confidence in government accolades as being due to the use of inspectors they perceived as being less experienced or qualified than themselves. Teachers also highlighted their concerns about the way inspectors were obliged to use government imposed approaches, prescribed language and protocols that they perceived as discredited. These teachers reported intensified frustration with inspections when the outcome was a favourable report, commenting that poor reports, however unwelcome and damaging to themselves and their schools, were at least able to be dismissed by the teachers concerned as lacking professional credibility and authority. Favourable reports, on the other hand, whilst welcome and useful for the school's brochures and the recruitment of students and staff, left many of these teachers feeling that in accepting a favourable report they had been coerced into supporting a system of which they strongly disapproved.

Table 4.5 Extract of post-intervention teacher reflection – Inspection.

I have lots of friends in other schools who say it's the same there as it is here … management thinks using (learning) styles shows we are professional, because we're using tests to measure ways of learning - and parents like it too, because they do seem to make sense, don't they? They make a lot more sense to parents than the SATs, which the pupils hate too and I think are a waste of time, but you notice that the government backs them without questioning whether they work, doesn't it? *Teacher 'B'.*
It's not what I would do if I had the choice, but so much is dictated these days and you can't afford to go out on a limb in case you get a bad (inspection) report. I don't take them too seriously but they seem to impress the LEA and it looks good in the Prospectus. *Teacher 'M'.*
One or two of our governors are enthusiastic about them and they're very supportive of the school, so the Head likes us to be seen to take their ideas seriously. *Teacher 'J'.*
The Deputy (Head teacher) in charge of this is really sold on these things and she's made it a real feature of work here – she gives presentations at Parent's Evenings about how we use learning styles and there's always an impressive display of the kids' work to show how we use all the different styles. How do you climb down from that? *Teacher 'G'.*

According to the English teachers in the four schools, school inspectors' interest in seeing them match individual pupil differences to varied provision within their lessons presented them with particular challenges that actually made the use of the LSI-2 and LSQ more likely. This was because they felt that in order to strengthen the likelihood that they would be judged to be an expert practitioner, teachers needed to provide objective evidence to support the way they identified individual differences that, crucially, *did not rely only on their unsupported professional judgment*. The role of this *professional* accountability to school inspection was therefore seen to be a strong influence on their classroom behaviour.

Table 4.6 Extract of post-intervention teacher reflection – Accountability.

The inspector who observed my lessons said I was an 'outstanding' practitioner and he made a point of commenting favourably on the way I used learning styles – he thought it was, well, really professional and showed how I used evidence to inform practice. He seemed quite impressed by it. *Teacher 'A'.*
What would you say to the inspection team next time they came if you'd stopped using them? *Teacher 'E'.*
These days it's not enough to say you have decided to do things a certain way because that's what your training and experience indicates is best to you. That's not 'objective' and people are much more likely to challenge a professional judgement. It was different when I started teaching but times have changed – it's less about what *you* think now, however professional you might be seen to be, and more about exam results and covering your back. *Teacher 'F'.*
You can say that doing things a particular way is in your opinion the best for a particular child and you can tell them (inspectors) that you use your judgment to plan what would be best to do next, but what are you going to say when they ask you where your evidence is? It's not that they're unpleasant or aggressive, but that they've got their own tick-list of things they're looking for and what they think does and doesn't count as best practice. *Teacher 'L'.*

For the schools in this study it was the case that the LSQ and LSI-2 possess considerable face validity and that this is the most significant factor in explaining why they make extensive use of their outputs to inform pedagogy and to influence the assessment strategies that are used in the schools. In these schools the judgments of external inspectors clearly also contributed to the continued use of learning styles (Table 4.6).

Several teachers reported that they were also required by *school policy* to show how they made use of measures of learning style in their lesson planning, which was monitored by the school, so abandoning the use of learning styles was not perceived to be an option, particularly in two of the schools where a member of the school's senior management team had the oversight of learning styles as part of their role and inspected each teachers' lesson plans thoroughly every week (Table 4.7).

Table 4.7 Extract of post-intervention teacher reflection – School Policy.

This is my first job and it's not a permanent post, so I don't think it's a good idea for me to rock the boat. Anyway, I don't really disagree with it – but it's school policy anyway. *Teacher 'K'.*
We were all asked what we thought about this a couple of years ago. Not everybody was keen but quite a few staff think using learning styles works well. The decision to use them was made by management and the governors. You can't really just say you don't agree and refuse to do it, especially as I'm Head of Department and it's me that has to check lesson planning for my staff every week and sign-off that they're following policy on this. *Teacher 'E'.*
The senior team are committed and as long as everybody supports it and works together on things like this, we can get a lot of benefit as a school. Part of being professional is about working with your colleagues. *Teacher 'D'.*

Many teachers involved in this study also recalled that during their *initial teacher training* they had attended lectures about learning and teaching styles where the various instruments used to provide measures of these were advocated for use but without any significant attention being drawn to research that questioned their efficacy or educational value (Table 4.8). This seemed surprising, but almost all the teachers involved confirmed that they were unaware of the body of research critiquing learning styles and associated instruments. Teachers claimed they had no recollection of being exposed to this information during their training and further study and that since that time they had had relatively little (in most cases no) contact with research literature. These teachers felt that they were not unusual in excluding the places where research was published from their customary reading. Most commented that apart from relevant professional press such as the Times Educational Supplement (read by about two thirds of teachers in the sample) any reading they engaged in about their work was confined to government reports or policy documents with which they were required to comply. This situation may not just be about the way these teachers perceive the relevance or importance of peer-reviewed research. It may also in part be an unanticipated outcome of the more prescriptive approach to the training of teachers and of a more highly directed curriculum and associated pedagogy that has appeared in the UK in recent years (Somekh, 2000). Teachers' lack of familiarity with research that is critical of particular educational interventions may also be related to the difficulties sometimes experienced by academics in securing publication in peer reviewed journals for negative findings.

Table 4.8 Extract of post-intervention teacher reflection – Initial Training.

I don't agree with those who criticise (the use of learning styles) – I think it works and in my dissertation for my degree I got a good mark for writing about learning styles and showing how they can fit in well with individualised learning. *Teacher 'A'.*
Maybe partly it's because you don't see much research published about things that don't work, only things about people claiming that the stuff they've done is wonderful. *Teacher 'I'.*
I don't think I've come across any real evidence that there's anything wrong with learning styles. Most of the negative comment seems very statistical. I worry about that a bit, because it seems ... well, almost contrived some of the time, you know? *Teacher 'G'.*
I can't remember the last time I read any proper research. When I was at uni(versity) I suppose. Most often now the debate seems dominated by what this or that report has said and more often than not those are written by government agencies. On the few occasions you hear politicians talking about what research has found out, it's that kind of thing they're talking about, not something that's appeared in a journal. Funny really, because it's often the other way round when people are talking about things like medicine. *Teacher 'J'.*

Finally, the perspective of *classroom pedagogy* was invoked. Teachers commented that in addition to the factors already raised in the discussions described above, they were also relatively unperturbed by the lack of reliability and validity of the LSI-2 and the LSQ because they still found the underlying (face validity) premise of these instruments convincing. Any failure of these instruments to work reliably at the level of the individual student was not therefore seen to be of critical importance; most of the teachers commented that they did not in any case differentiate their practice at the level of a specific, individual student in such a targeted way – although many of them admitted candidly that in their lesson planning notes and associated reports they were inclined to present their classroom activity as though this was what they did. Instead, teachers said that whenever possible what they did was to provide a small number of different articulations or formats of lesson content, some designed to appeal to visually oriented learners, others which they thought would appeal more to learners who preferred to engage in practical activity and so on and that each of these variations was often also differentiated by level of intellectual challenge.

Which of these resources an individual student employed was often left for the student to decide for themselves and teachers reported that some students would use one of these and at other times several. Teachers said that in many cases they would place worksheets addressing several of these alternative approaches and levels of challenge at the front of their class, where students could elect to pick them up or not. There appeared to be little intervention by many teachers at the moment of decision, either to explore or inform the student's rationale for their choice of a particular resource, or to emphasise to them the value of making a thoughtful, reflective and informed decision as opposed to one founded on random choice or whim. The majority of teachers reported that they most often tended to use these worksheets as material for students who completed their class work early and characterised them as 'extension' work although it was clear that this was not their only purpose. One teacher confessed that she used these resources as 'busy work' to give students to ensure that all the class were seen to be being kept occupied through the entire lesson. Few records of this activity were kept by teachers and none by students and no teacher said they drew upon this kind of activity to inform individual students' future learning.

Teachers said they were more concerned that students felt encouraged to experiment and think about how they were learning than about whether the use of particular measurement instruments (or resources) produced meaningful outputs that were stable over time (Table 4.9). The outputs from learning style instruments therefore had their greatest utility for teachers in these schools in 'fending off' school managers and in addressing the requirements of inspection audits, as well as for deflecting pressure to modify their underlying classroom practice to conform with what were often seen and described by teachers as management 'hobby-horses' or government policy fads.

Teachers saw value in the LSI-2 and LSQ as means to get students thinking about how they learned and for many of them that was sufficient to justify their continued use, despite the fact that very little evidence was offered by them to suggest that they made any structured use of their students' thinking about their learning. Research has shown that teachers' beliefs about pedagogy can be highly resistant to both change and to short-term interventions and the responses of teachers in this study support this (Pajares, 1992; Phelan & McLaughlin, 1995; Wildeen et al., 1998).

Table 4.9 Extract of post-intervention teacher reflection – Classroom pedagogy.

Well it (learning styles) certainly motivates many students I teach. They think it's interesting and it opens their eyes to different ways of learning. Most of them never otherwise think about how they learn. *Teacher 'C'.*
Some just struggle to understand why they can't understand something and don't know how to get past it. Getting them to think about learning styles can sometimes change that. *Teacher 'D'.*
I make use of whatever opportunity comes my way if I think it will help my students learn – (learning styles) doesn't really affect the way I work or my underlying philosophy and I don't think it changes what makes a good teacher good. *Teacher 'H'.*

4.6 Conclusions and implications

Comments made by teachers are in line with findings that the (pre)existing beliefs of educators about pedagogy are likely to have a powerful influence on the conclusions they are inclined to reach about the merits of specific classroom practices (Becker, 2000; Hattie, 2009). The reflections by teachers on the perceived locus of control within their professional practice underscore the complexities that result when a performativity approach to teaching and learning meets teachers' desires for pragmatic solutions to the tasks they perceive to be most urgent and the pressures they feel most acutely.

Many of the teachers continued to support the proposal that individuals have preferred approaches to learning - though they conceded that their views were based largely on their own observations - and argued that they routinely 'matched' these to individualised instructional approaches although later discussion suggested that they actually adopted their own fairly standardised approach to classroom delivery for all their students. Typically, teachers said they promoted matching in class "through the use of different examples" or by "encouraging pupils to consider how different people might think about a given problem" or by providing "some concrete and some abstract ideas and situations to encourage different ways of thinking". Teachers' convictions about the efficacy of this approach rested heavily on their own experience and self-reinforcing notions of 'what works', rather than on any objective or research evidence.

When questioned about the effectiveness of matching individual styles to teaching approaches, many teachers admitted that little of this had actually happened in their classroom in any formal or structured way but reiterated that it was embedded or implicit in their practice. Some raised an interesting logical and pedagogic objection; matching may actually be counter productive. They argued that this may be especially the case where prior learning has not been successful, perhaps because a student's choice of approach was poorly aligned to a given scenario and content, or when new content or an unfamiliar learning domain had been encountered where prior approaches were an unhelpful guide. It was argued that under such circumstances students would benefit from access to a range of strategies to choose from and test. This marked an appropriate point to turn to the next stage of the study, where we were about to embark upon a new content area (Shakespeare's *Macbeth*) in an unfamiliar learning domain in this subject area (the use of multimedia software) and to test an alternative approach to understanding the interaction between individual students, resource use and learning.

The research question for the present stage of the study asked:

> Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

In the schools in this study the instruments developed by Kolb and Honey and Mumford for the measuring of learning styles were found to be unable to give an answer to this, because their outputs were incoherent and their results mutually incompatible; neither instrument was able to give valid and reliable outputs. The use of these instruments with the multimedia resource was not therefore possible although it is clear that learning styles were perceived by teachers to have value in other regards. If the ability of multimedia software to offer learners different content in different formats and at different levels of intellectual difficulty is of measurable benefit for individual learning, it seems from the present data that this may not lie with the adoption of learning styles.

The discussion from the data here provides a foundation for the next chapter in which Cognitive Load Theory is applied to research question 2(b):

> Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

The next chapter discusses this question and explores the contribution to the design of instructional materials and the understanding of the effects of its use on learning that may be made by Cognitive Load Theory. This next stage of the study directly examines the relationship between the format of learning resources and individual learning. The theoretical underpinning of Cognitive Load Theory are discussed and related to its implications for multimedia.

Chapter 5 – Data analysis: Cognitive Load Theory and Multimedia

5.1 Introduction

Drawing on the background of literature about the use of computers in educational contexts published since the 1980s, the literature review (Chapter 2) discussed the first research question:

> What are the educational implications of using computers and multimedia software in schools that have been identified in published research?

and identified the use of Learning Styles theory and Cognitive Load theory as two prominent and promising approaches for exploring and answering the two parts of the second research question:

> 2(a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
> 2(b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

An analysis of relevant literature identified a specific sub-question with regard to part 2(a):

> Do the instruments developed by Kolb and Honey and Mumford for the measuring of learning styles offer benefits for improving individualised instruction and what are the implications for the use of multimedia?

and the previous chapter (Chapter 4) set out the investigation of Kolb's LSI-2 and Honey and Mumford's LSQ to answer this sub-question and, following this, discussed the extent to which learning styles could be usefully incorporated into the study of multimedia use and learning in English Literature classes in the schools involved. It is clear that whilst Learning Styles and the use of the two instruments above retained considerable appeal for teachers in these schools

and their continued use seemed very likely for a number of reasons, the investigation of their reliability and validity raised serious concerns about using them to facilitate individualised learning and there was no evidence that they could be useful in designing or using multimedia resources for this purpose.

During the discussions about how the experienced teachers in the four schools in this study employed learning styles in practice in their classrooms on a daily basis (Chapter 4), they talked about the existing resources they most frequently used in their classrooms and explained how they routinely deployed them. It was clear from their accounts that whilst many of these teachers believed strongly that it was important to offer students a range of different resources that aimed to support different approaches to learning and to target different levels of academic challenge, they did not in practice make use of these resources in a way that was closely linked to individual student learning experiences, students' prior learning or link them to specific learning styles as indicated by their use of either the LSI-2, the LSQ. Neither did these teachers make direct or consistent use of their own observations about or impressions of the learning styles that individual students may have. In the next stage of this study attention was therefore directed more closely at exploring the intuitive but unfocussed link that teachers strongly felt existed between the potential of different resources to support individual learning gains. The present chapter therefore addresses the next stage of the study as set out in research question 2(b):

> Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

and compares the learning gains made by students using the established resources commonly employed by the teachers in the four schools with those made by students also using the multimedia software. Cognitive Load theory is discussed as a means of understanding the outcomes of this intervention, as set out in the Methodology (Chapter 3). The implications of Cognitive Load theory for the use of educational multimedia and the use of the resources usually employed by the English teachers in the four schools is considered in the light of the learning gains made by students in these two different groups.

5.2 Instrumentation

As discussed more fully in the Literature Review (Chapter 2) Cognitive Load Theory seeks to explain why some material is more difficult to learn than other material by proposing that the human brain uses two types of memory: short-term memory (which has limited storage capacity) and long term memory (which is conceived as having unlimited storage capacity). The theory argues that these two types of memory enable the human brain to speed up task execution and solve complex problems by lowering the amount of mental processing (cognitive load) through creating *schema* that are stored in long term memory. These schema are cognitive constructs, chunks of organised knowledge, or classifications of problems into categories and organise multiple elements into single elements that allow us to speed up problem solving and task execution. With practice the use of established schema becomes automated and this can reduce the cognitive load experienced by learners and make the learning of difficult complex material more manageable. However, Cognitive Load Theory also identifies a number of key factors that may each independently increase the cognitive load on a learner when dealing with inherently complex material or when using unhelpful instructional resources. Poor instructional resources create unnecessary mental processing that is unhelpful for learning and this *Extraneous cognitive load* is the difficulty, or load on the learner's working memory, associated with the design of instructional materials and the way these present information to the learner. In contrast to this, *Germane cognitive load* is the load that is directed towards constructing, processing and automating schemas and this can also be manipulated by the instructional design but is helpful to learning because it results from features of the design which direct attention towards relevant learning processes. Finally, *Intrinsic cognitive load* is directly attributable to the inherent complexity or difficulty of the material to be learned, may not be changed by the teacher and is assumed to be unaffected by the instructional design and to be the product of a combination of the learner's prior knowledge and the intrinsic complexity of the learning material (Sweller & Chandler, 1994).

Previous studies of cognitive load have used subjective mental effort ratings to measure overall cognitive load (see Paas, 1992) but have found that learners who experienced the same overall cognitive load often achieved different learning outcomes (Tabbers et al., 2000).This might be thought to conflict with

what was expected in Cognitive Load Theory but Tabbers (ibid.) proposed that it could be due to increases in extraneous load being accompanied by decreases in germane load with some learning formats and *vice versa* with other learning formats (resulting in the same *overall* load for different students), or it may be to do with the influence of the student's subject expertise, or to their intrinsic ability or interest in the topic being studied.

To test whether differences in learning outcome are caused by the germane load that is attributable to the format of different instructional materials as discussed in the literature review (Chapter 2) and methodology (Chapter 3), a closer measurement of cognitive load is required. The text of *Macbeth* is the target area of the present study and so differences in the extraneous cognitive load imposed by two different instructional designs in teaching this subject matter were explored using one set of students who used the multimedia resource (the experimental group) and another set of students (control group) who instead used only teachers' established resources and approaches to teaching the same subject matter and did not use the multimedia resource. Given that Cognitive Load Theory proposes that different types of resource formats will have a significant influence on the learning gains of individual students, it was expected that the germane load imposed on students by these different approaches could therefore vary. A measure of prior knowledge (Appendix 6) was used to allow for individual differences in intrinsic cognitive load attributable to learner expertise, in line with the findings of Kalyuga et al. (1998).

Subjects were asked to record how easy they found it to learn using different resources, by rating a selection of these for 'ease of learning' (i.e. the mental effort) they associated with different instructional materials for the story or plot, characters and themes and imagery of works of English Literature on a five point Likert-type scale from 1 (extremely difficult) to 5 (extremely easy). Subjects rated 23 exemplar teaching resource materials, representative of the repertoire of resources used by their English teachers, for the degree to which they found them easy to learn from; they also similarly rated 32 elements from multimedia titles from the same series as the *Macbeth* resource (Appendix 4 - Sample Booklet of exemplar resources). In accordance with Cognitive Load Theory, these ratings were used as proxies for that element of germane load that is attributable to the format of the instructional resource being used.

Teachers within the four schools checked these resources (and the multimedia resource content) against a collectively-constructed measure of knowledge and understanding which was applied pre- and post-intervention. This was to ensure that measures of relative change in scores could be meaningfully used for both experimental and control groups and that the test included measures of knowledge and understanding that the teachers felt could be gained equally from all types of resource.

The test was a thirty-item paper-based assessment that was completed individually by participants in the normal class session immediately preceding the start of the intervention and before the study of the selected text began (Appendix 6). The test focussed on a selection of key areas of knowledge and understanding required for success in GCSE English Literature examinations and items were closely related to the text and subject syllabus specifications; there were ten questions about key characters in *Macbeth*, ten about important themes and images found in the play and ten about its structure and cultural context (Appendix 6)(see also AQA, 2008, 2009; Edexcel, 2009; QCDA, 2011). Each section of the test included questions in open-ended, multiple-choice and short essay formats. The post-test used this same instrument and was completed under the same conditions ten or eleven weeks later (variations being due to differing lengths of half terms between schools). The scores from these two tests were compared to obtain a measure of learning gains made about *Macbeth*.

In order to reduce the strength of any possible Hawthorne Effect in the experimental group using the multimedia resource (which might have been generated by the letter to parents informing them about the study - see page 289), where an increase in 'productivity' (the scores on the knowledge and understanding test) could be produced by the psychological stimulus of being singled out and made to feel important (Franke & Kaul, 1978), those students who were using the multimedia application were told that this was simply one of several different types of resource that were used for studying the text, that they may or may not find it useful but that, by itself, it was not expected to make any real difference to their learning, as this would be mainly the result of how hard they worked in class and on their homework study tasks, just as for any other student. Students were not informed of their results from the pre-test, or that the

test would be re-used at a later date so as minimise the likelihood that they might try to remember their responses to the first test or to consciously recall its questions when learning about Macbeth in preparation for the re-test.

5.3 Results

5.3.1 Overall results and results by school

In order to compare the two groups of students a paired sample t-test for the experimental (multimedia) group and for the control (non-multimedia) group was conducted to measure the pre-test and post-test results for knowledge and understanding and this shows a highly statistically significant improvement in mean scores for knowledge and understanding, where the difference between the means for the two groups of students is 21.485 - 19.076 = 2.409 (ρ=.000)(Table 5.3).

Table 5.3 indicated that the experimental groups recorded a higher *difference* than the control groups in the gains made in their scores between the pre-test and the post-test. For example, whilst the experimental (multimedia) groups recorded a mean gain of 21.48 points (the difference between pre-and post-intervention scores), the control groups recorded a mean gain of 19.076 points.

In other words, the difference in the mean gains between the two groups was 2.41 which, out of the maximum possible score of 30 represents an 8.03 per cent difference (Table 5.9).

Table 5.3 Paired samples t-test results for experimental and control groups: values = post-intervention scores minus pre-intervention scores.

	Paired Differences							
				95% Confidence Interval of the Difference				
Group	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Experimental	21.485	2.175	.110	21.269	21.700	196.112	393	.000
Control	19.076	2.123	.107	18.866	19.286	178.336	393	.000

NOTE: The post-test difference between experimental and control groups, after removing the natural maturation (the increase in scores common to both groups that might therefore have happened with or without the use of multimedia), is calculated by:

(Experimental group post-test minus pre-test)
minus
(Control group post-test minus pre-test)
= (27.04-5.56) minus (24.63-5.56)
= 21.48 - 19.07
= 2.41

For the pre-test no statistically significant difference was found between the overall means of the experimental and control groups ($p>.05$) so for statistical purposes in this respect they can be regarded as matched at the start of the experiment. However, for the post-test the difference between the overall means of the experimental and control groups was highly statistically significant ($p=.000$).

An independent samples t-test for the pre-intervention test showed no statistically significant difference between the scores of the experimental (multimedia) group and the control (non-multimedia) group (both are 5.56)(Table 5.4). However, for the post-test there is a highly statistically significant difference between the two groups, with the experimental group mean score being 27.04 and the mean score of the control group being 24.63 ($\rho=.000$)(Table 5.4). This indicates that whilst the experimental (multimedia) and control (non-multimedia) groups were comparable in their knowledge and understanding of Shakespeare's *Macbeth* before the intervention this was not the case after the intervention and that these differences are highly statistically significant (Table 5.4 and Table 5.5).

Table 5.4 Independent samples t-test results for experimental and control groups: group statistics (Exp = Experimental [multimedia] Group; Cont = Control [non-multimedia] group).

		N	Mean	Std. Deviation	Std. Error Mean
Pre-intervention scores	Exp	394	5.56	1.907	.096
	Cont	394	5.56	1.907	.096
Post-intervention scores	Exp	394	27.04	2.367	.119
	Cont	394	24.63	2.689	.135

Table 5.5 Independent samples test results for experimental and control groups.

Intervention scores		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre	= variances assumed	.000	1.000	.000	786	1.000	.000	.136	-.267	.267
	= variances not assumed			.000	786.000	1.000	.000	.136	-.267	.267
Post	= variances assumed	10.822	.001	13.346	786	.000	2.409	.180	2.054	2.763
	= variances not assumed			13.346	773.579	.000	2.409	.180	2.054	2.763

To ascertain whether there might be any statistically significant differences between the four individual schools at the pre-test stage (the start of the intervention), Analysis of Variance (ANOVA) and the post hoc Tukey test were conducted on the four experimental groups and on the four control groups. When, as here, there are several different groups in a sample the post hoc Tukey test for Honestly Significant Difference (HSD) can be used to find out which of the groups are different from each other and where the differences are. ANOVA found that there were statistically significant differences between the four schools at the pre-intervention (pre-test) stage for both the experimental and control groups (p=.009)(Table 5.6). ANOVA in SPSS also reports the F-ratio, which is the common measure of the ratio of variance that is explained by the analysis (here of the difference in scores in knowledge and understanding) as compared to the amount of variation that could be attributed to natural

differences in ability. This ratio is sometimes referred to as the difference between the measure of *systematic variation* (the differences brought about by the experiment) compared to the *unsystematic variation* (the effect of the natural differences in ability) (Field, 2006). This value must by definition therefore be more than 1.0 if there is a statistically significant effect; larger F-ratios indicate more likelihood that the differences between the means are due to something other than chance alone and the value found here (F=3.950) can be regarded as indicating that the differences found between the groups are highly unlikely to be due to chance (Table 5.6).

The pre-intervention differences between the four schools is also confirmed in the Tukey HSD test, which groups subsamples together where their means are similarly homogenous and here found that the means for the four schools were statistically significantly different at the pre-intervention testing stage with the mean for School 1 being relatively low (5.13), which was some distance away from the next lowest mean of 5.53 (School 4), and school 2 being relatively high (5.87) and being some distance away from the next highest mean of 5.83 (School 3)(Table 5.7).

Table 5.6 ANOVA intervention pre-test scores.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.142	3	14.047	3.950	.009
Within Groups	1387.016	390	3.556		
Total	1429.157	393			

Table 5.7 Tukey's HSD Test: pre-intervention scores.

Tukey HSD[a,,b]

		Subset for alpha = 0.05	
School	N	1	2
School 1	133	5.13	
School 4	59	5.53	5.53
School 3	102	5.83	5.83
School 2	100		5.87
Sig.		.059	.609

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 90.351.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

At the post-intervention testing stage, ANOVA and the Tukey test found that the means for the four Schools in the experimental (multimedia) group were not statistically significantly different (p=0.966) whereas in the control (non-multimedia) group the means were statistically significantly different (p=.003)(Table 5.8).

Table 5.8 ANOVA Post-intervention scores.

		Sum of Squares	df	Mean Square	F	Sig.
Multimedia Group	Between Groups	1.504	3	.501	.089	.966
	Within Groups	2200.762	390	5.643		
	Total	2202.266	393			
Control Group	Between Groups	100.477	3	33.492	4.766	.003
	Within Groups	2740.893	390	7.028		
	Total	2841.371	393			

In the associated Tukey test, whilst the means for the multimedia groups in the schools are clustered around the value of 27.00 it can be seen from Table 5.9 that the mean for the control group in School 1 (23.95) is some distance away from the next lowest mean (School 4: 24.83) with the mean for the control group in School 3 being some distance away from the next highest mean (School 2: 24.89).

Table 5.9 Tukey's HSD Test: post-intervention scores.

Tukey HSD[a,,b]

	School	N	Subset for alpha = 0.05	
			1	2
Multimedia Group	School 2	100	27.00	
	School 1	133	27.02	
	School 3	102	27.04	
	School 4	59	27.19	
	Sig.		.952	
Control Group	School 1	133	23.95	
	School 4	59	24.83	24.83
	School 2	100	24.89	24.89
	School 3	102		25.17
	Sig.		.081	.829

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 90.351.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

There are improvements in student scores for knowledge and understanding in all the schools and for both the experimental and control groups, as would be expected after some ten or eleven weeks of teaching and learning about Shakespeare's *Macbeth*. However the students using multimedia in all four schools made larger gains in knowledge and understanding than any of the non-multimedia groups, although Table 5.9 shows that the multimedia group in School 4 made the largest gain amongst the experimental groups and that the non-multimedia group in School 3 made the largest gain in the control groups, though these were each only a little higher than those in the other three schools, respectively.

Exploration of this variability between groups of students within the four schools is of interest, especially for the teachers in these schools, who were interested in finding out why the measures of overall gain in knowledge and understanding varied between and within schools. For example, the pre-test mean score for knowledge and understanding was lower for students in School 1 – both for the multimedia (experimental) and non-multimedia (control) groups (5.13) – than for students in any of the other schools, but the use of multimedia in this school produced the largest absolute increase in average scores over the students in the non-multimedia group in all schools (3.07) (Table 5.9). Contrarily, the use of multimedia in the single-sex school (School 3) produced the smallest absolute increase in average scores over the non-multimedia group in any of the four schools (1.88), despite this school having one of the highest overall pre-intervention scores for knowledge and understanding of *Macbeth* for both multimedia and non-multimedia groups (5.83)(Table 5.10).

Table 5.10 Composite table of scores for all schools, by sex (M=male, F=female)

		School 1			School 2			School 3	School 4		
		All	M	F	All	M	F	F	All	M	F
Multimedia (experimental) group	Pre-intervention score	5.13	4.91	5.33	5.87	5.73	6.00	5.83	5.53	5.75	5.32
	Post-intervention score	27.02	26.44	27.55	27.00	26.39	27.59	27.04	27.19	27.04	27.32
	Difference between pre-and post-intervention scores (Mean Gain)	21.89	21.53	22.22	21.13	20.65	21.59	21.21	21.66	21.29	22.00
	Significance level (difference between pre-and post-intervention)	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000
Non-multimedia (control) group	Pre-intervention score	5.13	5.39	4.88	5.87	5.57	6.16	5.83	5.53	5.74	5.34
	Post-intervention score	23.95	24.25	23.67	24.89	24.55	25.22	25.17	24.83	24.81	24.84
	Difference between pre-and post-intervention scores (Mean gain)	18.82	18.86	18.78	19.02	18.98	19.06	19.33	19.30	19.07	19.50
	Significance level (difference between pre-and post-intervention)	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000	ρ=.000
	Relative increase in scores (experimental compared to control group)	3.07	2.67	3.44	2.29	1.67	2.53	1.88	2.36	2.22	2.50
	Equivalent % increase in scores (experimental compared to control group)	10.23	8.90	11.47	7.63	5.57	8.43	6.27	7.87	7.40	8.33

Table 5.10 indicates that the mean difference between the scores of the experimental groups (the ones that used multimedia) on the pre-test and the post-test were statistically significant (p=.000). Similarly, the mean difference between the scores of the control groups (non-multimedia) on the pre-test and the post-test were statistically significant (p=.000). In other words, both the experimental and the control groups recorded statistically significant increases in their scores between the pre-test and the post-test, which were separated by a period of between ten or eleven weeks.

These data suggest that the use of the multimedia resource in the four schools improved scores of knowledge and understanding in English Literature substantially beyond those achieved without the resource, but there was no consistent linear relationship between the pre-intervention scores and post-intervention scores (i.e. the relative gain in knowledge and understanding) of students that used the multimedia resource. In these four schools there was a large and statistically significant 'multimedia effect' in evidence in the increases in the scores for knowledge and understanding but these relative gains did not appear to be directly related to the intrinsic ability of students as identified, for example, by pre-intervention scores. This was a query that also arose during my first exposure to the reaction of students to computers back in the 1980s as I noted the way students differed in the ease with which they engaged with word-processing software, but much less so with *Zork!* (see Chapter 1 - Introduction). This indicated that it may have been the content and format of the resource itself that was responsible for the outcomes observed and suggested that further analysis of the data in the current study was required and particularly of other potentially influential variables. In order to contextualise such a further analysis it is necessary to set the present work in the context of other variables that are often proposed as primary influences on attainment, such as the sex of the student or the particular school that they attend.

5.3.2 Results by sex

GCSE examination pass rates have continued to rise in the UK over the last 23 years but there remains a persistent and, especially in the case of English, a growing difference in performance between males and females, although at ‘A Level’ this gap is now closing. This phenomenon continues to attract comment

and concern in both the media (BBC, 2011a, 2011b; Guardian, 2011; Mail Online, 2011) and in government reports (DfCSF 2007, 2009a, 2009b).

A closer inspection of the data revealed that statistically significant differences between the mean scores for mixed-sex schools at both pre- and post-intervention stages are present for sex, although there was no consistent direct relationship between sex, an individual school and the mean gains for multimedia or non-multimedia groups.

The data were therefore processed and analysed by the sex of the students (Tables 5.11 and 5.12). The average gains in knowledge and understanding test scores in the four schools ranged from 6.27% (School 3) to 10.23% (School 1), with the highest score being for females in School 1 (11.47%) and the lowest being for males in School 2 (5.47%) (Table 5.10).

The overall pre- and post-test scores for males and females in the experimental and control groups, for schools and for males and females within each school were examined for differences between the pre-test and post-test. On the English Literature knowledge and understanding variable, the results are shown in Table 5.5. For males the mean score for knowledge and understanding (from a maximum score of 30) for the pre-test was 5.44 (SD=1.864); for the post-test it was 25.51 (SD = 2.924) and the mean percentage improvement between pre- and post-test scores was 66.88 (SD = 8.565). For females the mean score on the pre-test was 5.62 (SD = 1.927) and for the post-test it was 26.02 (SD = 2.720), with a mean percentage gain of 68.00 (SD = 7.985).

Table 5.11 Pretest and post-test scores for knowledge and understanding, by sex.

	Sex	N	Mean	Std. Deviation	Std. Error Mean	Statistical significance between males and females
Pre-test	Male	281	5.44	1.864	.111	.199
	Female	507	5.62	1.927	.086	
Post-test	Male	281	25.51	2.924	.174	.015
	Female	507	26.02	2.720	.121	
Percentage gain between pre-test and post-test	Male	281	66.88	8.565	.511	
	Female	507	68.00	7.985	.355	

Tables 5.3 to 5.11 indicate that, for the pre-test, the results of the males and females did not differ statistically significantly (p>.05). As shown in Table 5.11,

for the post-test the results of the males and females differed statistically significantly (p=.015). There was a highly statistically significant difference between males and females in the sample for the overall difference between pre-test and post-test scores and for the relative measure of learning gain in knowledge and understanding, with females achieving larger gains (8.33%) relative to males (7.47%)(Table 5.12). A similar pattern obtained in each of the three mixed-sex schools, where females using the multimedia resource gained larger improvement than males using the multimedia resource.

In School 2, females scored higher than males at both pre-test and post-intervention stages in both the control and experimental groups. In School 1, females scored higher than males in the experimental group but in the control group males scored higher than females, although the mean gain of the experimental group as a whole (22.22) was still greater than that of the control group as a whole (18.78) and a similar situation existed in School 4. In control groups, knowledge and understanding scores improved more for males than females in School 1 but these gains were reversed and equalled or exceeded in size by females in all the other schools.

Table 5.12 Pre-test and post-test results for all schools combined, and for males and females.

Pre-test and post-test results for all schools		Means of all schools combined	Means of all Males	Means of all Females
Multimedia (experimental) group	Pre-intervention score	5.56	5.44	5.67
	Post-intervention score	27.04	25.51	27.32
	Difference between pre-and post-intervention scores (Mean Gain)	21.48	20.06	21.65
	Significance level (difference between pre-and post-intervention)	p=.000	p=.000	p=.000
Non-multimedia (control) group	Pre-intervention score	5.56	5.52	5.58
	Post-intervention score	24.63	24.46	24.73
	Difference between pre-and post-intervention scores (Mean gain)	19.07	18.94	19.15
	Significance level (difference between pre-and post-intervention)	p=.000	p=.000	p=.000
	Relative increase in scores (experimental compared to control group)	2.41	2.24	2.50
	Equivalent percentage increase in scores (experimental compared to control group)	8.03	7.47	8.33

Females in the single-sex school (School 3) achieved the smallest mean gain for females in the experimental group (21.21) out of all four schools whilst females in School 1 achieved the largest gain (22.22). School 4 achieved the largest mean gain for females in all schools in the control group (19.50) and School 1 achieved the smallest (18.78). Males in School 2 achieved the smallest mean gain for males in the experimental group in the three mixed-sex schools (20.65) whilst males in School 1 achieved the largest mean gain for males in all schools in the control group (21.53). Overall, School 1 produced the largest mean gain for all students using multimedia (21.89) (i.e. experimental group) and the single-sex School 3 produced the largest mean gain for all students using non-multimedia (19.33) (i.e. the control group), closely followed by School 4 (19.30).

5.3.3 Interaction effects: sex, school and group

In view of the above observations, a two-way between-group analysis of variance was conducted to discover the interaction effects of sex, school and group (experimental or control) on performance in the examination of GCSE

English Literature competence. Table 5.13 shows that there was a statistically significant main effect for experimental/control group ("Group")(F = 200.816, ρ<.001, η^2 = .206).There was also a statistically significant effect for sex ("Gender")(F = 6.076, ρ = .014) and for the interaction effect for School*Group (F = 4.350, ρ = .005) but the effect sizes were small (Gender η_p^2 = .008; School*Group η_p^2 = .017). The interaction effects and effect sizes were also not statistically significant and were small as between School*Sex (F = 0.211, ρ = .810, η_p^2 = .001); Group*Sex (F = 146.156, ρ = .089, η_p^2 = .004); and School*Group*Sex (F = .177, ρ = .837, η_p^2 = .000) (Cohen, 1988). Table 5.12 indicates that the use or non-use of multimedia was the most important and substantial influence on improvements in learning the course content studied in each of the four schools (η_p^2 = .206). Put simply, the multimedia intervention exerted a stronger effect on the post-test scores than either the sex of the student or the school which s/he attended.

Table 5.13 Between-subject effects in a two-way ANOVA: the effect of school, group (experimental vs control), and sex on percentage gain in pre-test and post-test scores of knowledge and understanding.

Dependent Variable: Percentage gain

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13930.018[a]	13	1071.540	21.210	.000	.263
Intercept	3.047E6	1	3.047E6	60301.396	.000	.987
School	232.682	3	77.561	1.535	.204	.006
Group	10145.509	1	10145.509	200.816	.000	.206
Gender	306.968	1	306.968	6.076	.014	.008
School * Group	659.376	3	219.792	4.350	.005	.017
School * Sex	21.290	2	10.645	.211	.810	.001
Group * Sex	146.156	1	146.156	2.893	.089	.004
School * Group * Sex	17.923	2	8.962	.177	.837	.000
Error	39103.526	774	50.521			
Total	3.654E6	788				
Corrected Total	53033.544	787				

a. R Squared = .263 (Adjusted R Squared = .250)

So despite males and females in the sample having comparable starting points in terms of knowledge and understanding, females generally made larger gains

in scores for knowledge and understanding than males, whether they used the multimedia resource or not. However, there were variations away from this overall pattern within the schools and further analysis revealed that the use of the multimedia resource was a stronger predictor of gains in knowledge and understanding than either the sex of the student or the school at which they studied.

To establish more clearly what the correlational analysis meant, a measure of effect size (using Cohen's d) of the difference between the experimental and control groups on the post-test yielded an effect size of d=.896, which is a moderate to strong effect (Cohen, 1988). However, Cohen's d assumes that a normal distribution exists within the sample which, in the present case would mean that the experimental and control groups' produced a symmetrical distributions of marks on the post-test not a skewed distribution. This may be an unwarranted assumption because the mean values for either or both groups could mask a 'bunching' (skewing) of scores in one or more places within the range of scores from which the mean is calculated. Cohen's d is unreliable if a normal distribution is not present and so it can be helpful to compare its outputs using an instrument making no such assumption. Using such a calculation of effect size – the partial eta squared values (η_p^2) returned in SPSS – yielded an effect size of η_p^2=.185 which is a moderate effect (ibid). For the mean difference between pre-test and post-test (intervention) scores, the partial eta squared yielded an effect size of η_p^2=.989 which is very strong (Cohen, 1988).

So in reviewing the measures of statistical significance and effect size, the difference in scores for knowledge and understanding of Shakespeare's *Macbeth* of the groups using the multimedia resource, as compared to the scores of students who did not use the resource, was highly statistically significant and also produced a moderate to strong or very strong effect, depending on the measure used. However, the size of an effect, which is often more informative and for practical purposes more relevant than a statistical correlation, also needs to be distinguished from its *importance*. It is necessary to consider what these effect sizes mean in terms of the units of measure of the original variable which, in this case, is the improvement in knowledge and understanding that relates to the subject syllabus for an external examination in

English Literature. In order to clarify this, information about the way GCSE grades are allocated is required.

Grades for GCSE examinations in the UK are allocated using bands of marks with different ranges delimiting the grades at Higher or Foundation levels and the boundaries for ranges vary slightly between Examination Boards; those referred to here reflect the syllabus in use in the four schools. Table 5.14 indicates the grade boundaries used in the GCSE examinations set by the Examination Board used by the schools.

Table 5.14 Grades and grade-boundaries for GCSE English Literature (AQA, 2011b).

	Maximum Scaled Mark (%)	Scaled Mark Grade Boundaries for 'pass'							
		A*	A	B	C	D	E	F	G
English Literature A Tier H (Higher)	200 (100)	171 (85.5)	150 (75)	131 (65.5)	113 (56.5)	93 (46.5)	83 (41.5)		
Range from lower grade boundary		(10.5)	(9.5)	(9)	(10)	(5)			
English Literature A Tier F (Foundation)	200 (100)				105 (52.5)	88 (44)	71 (35.5)	55 (27.5)	39 (19.5)
Range from lower grade boundary					(8.5)	(8.5)	(8)	(8)	

The results of this study show that the mean gains of the experimental (multimedia) groups of students over the control (non-multimedia) groups represented an 8.03 per cent difference. Though gross differences were found in combining the results from the four experimental groups and in combining the results from the four control groups, nevertheless difference were found between each of the experimental groups in each of the four schools and also between the control groups in each of the four schools. The value of 8.03 per cent was the mean value across all schools and in some groups, such as females in School 1, this gain was 11.47 per cent (see Table 5.10). Looking at Table 5.14 it is therefore possible to see that teachers in these schools could, by making use of the multimedia resources discussed, have improved their students' average performance in English Literature by a margin in excess of one GCSE examination grade.

5.3.4 Cognitive load and resources

The teaching and learning resources used by the students were varied, and Cognitive Load Theory suggests that different kinds of resource could make different demands on students. It was therefore important to explore the kinds of demands made on students by the different resources that were used, including those in the multimedia package.

Cognitive Load Theory offers an explanation for the lack of a direct consistent relationship found between pre-test scores and post-test scores discussed above, by arguing that the critical factor in facilitating successful learning is the degree to which cognitive load is optimised and that, as discussed in the Literature Review (Chapter 2) and the Methodology (Chapter 3) this is the product of: instructional design (*extraneous* cognitive load); the effort expended in constructing, processing and automating schemas (*germane* cognitive load); and prior learning and intrinsic subject/topic difficulty (*intrinsic* cognitive load). The study in this thesis is primarily concerned with the relationship between instructional resources and learning and so is not directly focussed on the exploration of germane load, and is instead particularly interested in the relationship between learning, instructional design (extraneous cognitive load), prior learning and intrinsic topic or subject difficulty (intrinsic cognitive load).

Given the identical instructional resources used by students in the experimental (multimedia) groups in the study, it was deemed reasonable to expect that extraneous cognitive load (load associated with the design of instructional materials and the way these present information to the learner) was held constant for these students. According to Cognitive Load Theory intrinsic cognitive load is directly attributable to the inherent complexity or difficulty of the material to be learned and is composed of the combination of the learner's prior knowledge and the complexity of the learning material. For the purposes of the present study it was assumed that the part of intrinsic cognitive load attributable to the complexity of the learning material (*Macbeth*) was also constant for these students, as they were all studying the content of the same literary work. The remaining component of intrinsic cognitive load (prior learning) remains as the important variable and this was measured using the individual ratings of mental effort that students reported when they were learning with different resources

(which has been shown to be an effective proxy for this; see Kalyuga et al., 1998).

The individual ratings of mental effort were obtained following an introductory two-hour familiarisation period provided by the researcher and the class teacher using extracts from titles from the multimedia series of packages. After the familiarisation session, individual subjective ratings of the mental effort involved in learning were obtained from all students for a range of the relevant multimedia features and also for a range of exemplar classroom resources commonly used by the teachers in the four schools, using a paper-based questionnaire (Appendix 3) and accompanying illustrated workbook (Appendix 4). Ratings were used as proxy measures of the intrinsic cognitive load for each individual student attributable to each learning resource (equivalent to learner expertise).

Twenty nine different examples of resource (or resource components) were assessed, chosen to be representative of those used by the teachers in the four schools and also of those contained within the multimedia software. These examples were classified into four groups reflecting the key characteristics identified in Cognitive Load Theory as being critical for the levels of cognitive load that they imposed on the learner: (a) text only; (b) text accompanied by a number of graphical features that were integrated with the text; (c) text accompanied by unintegrated graphical features that seemed likely to invoke a split-attention effect; and (d) integrated multimedia elements from the multimedia resource. As discussed more fully in the Literature Review (Chapter 2) and Methodology (Chapter 3) resources producing a split-attention effect (unintegrated resources) are those which require the learner to mentally integrate disparate sources of information (such as physically separated pictures and text, or text and pictures in proximity but which replicate the same content in these different formats) and integrated resources are those which have been designed to eliminate or minimise this effect.

Exploratory principal component factor analysis was used to investigate the underlying constructs within the data from the students concerning these resources. It was expected that the mean scores given by students for different individual resources would not all intercorrelate because learners would be highly unlikely to find every resource equally easy to learn with and so

Varimax rotation was applied to the data so that the rotated component matrix would maximise the differentiation of the original variables (different resources) by extracted factor. From the data four clear components were extracted using this method with Eigenvalues greater than 1.00, and these accounted for 64.489 per cent of the total variance explained

Small coefficients were initially suppressed in the rotated component matrix at the .50 level in order to reveal only the largest coefficients but one item (non-multimedia non-interactive maps [P5 NM Maps] in Table 5.15) did not initially appear to load onto any component at this value but increasing this to an absolute value of below .10 produced an output for P5 NM Maps loading most strongly onto component 1 and this additional value was therefore added to the output (Table 5.15).

Table 5.15 Rotated component matrix for resources used.

Rotated Component Matrix

	Component			
	1	2	3	4
P1 NM Text				.802
P2 NM Text				.812
P3 NM Text				.561
P4 NM Text				.662
P5 NM Maps	.465			
P6 NM Text and illustrations - Integrated	.657			
P7 NM Text and flowcharts - Integrated	.717			
P8 NM Text with icons - Integrated	.661			
P9 NM Text and summary boxes - Integrated	.591			
P10 NM Text and summary boxes - Integrated	.706			
P11 Text with illustrations - Integrated - Integrated	.566			
P12 NM Text with icons and précis - Integrated	.641			
P13 NM Text with icons and précis - Integrated	.648			
P14 NM Text - Integrated	.691			
P15 NM Text and questions and quotations - Integrated	.677			
P16 NM Text with illustrations and icons - Split		.532		
P17 NM Text questions - Integrated	.509			
P18 NM Text with illustrations and icons - Split		.625		
P19 NM Text with illustrations and icons - Split		.663		
P20 NM Text with graphic features - Split		.683		
P21 NM Text with graphic features - Split		.805		
P22 NM Text with graphic features - Split		.735		
P23 NM Text with graphic features - Split		.692		
P24 M Interactive menu screens with Animation - Integrated			.688	
P25 M Images of scenes from the plot with Animation and Voiceover - Integrated			.690	
P26 M Maps with Animation - Integrated			.735	
P27 M Questions with Animation - Integrated			.691	
P28 M Text on background analysis with Animation and Voiceover - Integrated			.775	
P29 M Pictures of historical events/places with Animation - Integrated			.736	

The four extracted components were comprised of resource elements that permitted the following description and classification (Component numbers below relate to Table 5.15 above):

- Factor One (Component 1): Non-multimedia text resources that were accompanied by illustration elements that were integrated with the text (22.055 per cent of total variance explained);
- Factor Two (Component 2): Non-multimedia text resources unaccompanied by other features (16.759 per cent of total variance explained);
- Factor Three (Component 3): Non-multimedia text resources that were accompanied by illustration elements that were not integrated with the text and which were highly likely to produce a split-attention effect (15.699 per cent of total variance explained);
- Factor Four (Component 4): Multimedia resources with integrated elements such as animation and/or speech (9.976 per cent of total variance explained).

The items comprising these four components (factors) were scored by students for how helpful they found them for learning (using a 5-box Likert-type scale from 'very unhelpful' for learning to 'very helpful' for learning)(Appendix 3). The student selections were reverse-scored for the purposes of coding and analysis (from 5 to 1) such that lower scores for a given resource indicated that students found it easier to learn with that resource and higher scores indicated that students found it more difficult to learn with that resource. Scores for the overarching factors themselves were created using the mean value of the scores for the components for each factor. The results are reported in Table 5.16. Researchers in the field of Cognitive Load Theory have demonstrated that such scores are reliable proxies for learner expertise and thus for the level of germane load imposed on the learner by instructional materials (Salomon, 1984; Kaluga et al., 1998, 2003; Cierniak et al., 2009).

As extreme levels of cognitive load are detrimental to learning (Young & Stanton, 2002; van Merriënboer & Sweller, 2005) one would expect that variations in scores for these resources would be closely associated with (i.e. would predict) measures of learning gains when controlled for resource type

represented by the components (factors) identified in Table 5.15. Cognitive Load Theory would predict that students who reported that they found a particular resource very difficult to learn with would gain less knowledge and understanding from using it than students who reported that they found the same resource very easy to learn with.

Table 5.16 Scoring for different resource types, where 1 = very helpful (easy) for learning and 5 = very unhelpful (difficult) for learning; resources with the lowest scores are deemed the easiest (most helpful) for use in learning.

	Experimental group mean	Control Group Mean
Factor One	3.81	3.86
Factor Two	3.92	3.92
Factor Three	3.83	3.87
Factor Four	3.64	3.71

Table 5.16 indicates that both the experimental and control groups found that Factor Four – multimedia resources with integrated elements such as animation and/or speech – provided the greatest ease and the lowest degree of difficulty for learning, whereas Factor Two – non-multimedia text resources unaccompanied by other features – provided the greatest degree of difficulty when learning. Regardless of whether a student was in the experimental or control group, the same progression of ease was found, from hardest to learn with to easiest to learn with: non-multimedia text resources unaccompanied by other features proved the most difficult; followed, as second most difficult, by non-multimedia text resources that were accompanied by illustration elements that were not integrated with the text and which were likely to produce a split-attention effect; followed as third most difficult (second easiest) by non-multimedia text resources that were accompanied by illustration elements that were integrated with the text; and the easiest to learn with were multimedia resources with integrated elements such as animation and/or speech. Clearly, the more integrated and animated were the resources, the greater was the easing of cognitive load, and the use of multimedia (factor Four) provided the greatest easing of cognitive load (cf. Mayer & Moreno, 2002). When ANOVA and the post hoc Tukey test were conducted on the four means of the experimental group and the four means of the control group, the mean for Factor Four was statistically significantly different from the means of the other

three factors (p = .008) for both the experimental and control groups, that is, using the multimedia software made a statistically significant difference to the cognitive load, easing it, for both the experimental and control groups. This was particularly the case for the experimental group, where the mean for Factor 4 (3.64) was substantially lower than that of the control group (3.71) and showed the greatest difference between the experimental and control groups of all the four factors (see Table 5.15); for the experimental group, the mean for Factor 4 (3.64) was .17 distant from the second lowest score (3.81), and for the control group it was .15 distant from the second lowest score (3.86). Both of these distances are in stark contrast to the distances between the second lowest and the highest scores for each group: .11 for the experimental group and .06 for the control group.

5.4 Discussion

It is clear that cognitive load was eased by the use of multimedia, and that the greatest easing was where multimedia were integrated with animation, audio, explanation, and background analysis. These finding also indicate that Cognitive Load Theory can offer both a useful explanation for the findings, and that it can also assist the teachers of English Literature in these schools in planning their teaching, particularly in terms of the resources that they use. This is in contrast to Learning Styles theory which, as was seen in Chapter 4, was unable to provide reliable guidance for resource use in this way. Intrinsic cognitive load in English Literature teaching and learning can be rendered more manageable by the use of integrated and advanced multimedia that move beyond the display of only text to using animation, background materials, and voice-over commentaries.

Cognitive Load Theory argues that *germane* cognitive load (the load directed towards constructing, processing, and automating schemas) can be manipulated and optimised by good instructional design in ways that help learning by directing attention more towards relevant learning processes. The findings here show that this outcome was achieved more by the multimedia resources used than by the other resources used and that this benefit was progressive across the different media in line with the expectations of Cognitive Load Theory. This finding supports those found in other studies mentioned

earlier (Cierniak et al., 2009; Kalyuga et al., 2003, 1998; Mayer 2008, 2009; Mayer & Moreno, 2002; Schnotz & Kürschner, 2007;).

In comparison to the other (non-multimedia) resources used, including those customarily employed by the teachers in the four schools, the multimedia also produced lower *extraneous* cognitive load on working memory, which is the load created as a result of unnecessary processing caused by instructional design and, if it is too high, is unhelpful for learning. The findings here also show that, because of the above outcomes, the multimedia resource was helpful in moderating the effects of the *intrinsic* cognitive load attributable to the inherent complexity and difficulty of the material to be learned (*Macbeth*) by offering learners who each had relatively little prior knowledge of this literary work the integrated resources that Cognitive Load Theory predicts will be most helpful in facilitating the creation of the schema required for learning.

The research question asked:

> Can multimedia software enhance student achievement at GCSE level? Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to more established or traditional classroom teaching and learning approaches?

Whilst acknowledging the limitations set out above, the findings here suggest that multimedia can have a positive influence on student achievement and that it can have a stronger positive influence than other resources, especially those likely to encourage a split-attention effect. The teachers in the four schools could therefore make use of Cognitive Load Theory to improve the learning of their students, particularly in the teaching and learning of inherently complex and challenging material like Shakespeare's *Macbeth*. Cognitive Load Theory has been shown to be more successful than Learning Styles Theory for understanding the relationship between the use of different resources and learning and has proved successful in showing how the use of active and interactive multimedia techniques can be valuable in easing that degree of cognitive load which is counter-productive to effective and efficient learning. This chapter has suggested that Cognitive Load Theory can make a significant contribution to understanding the limiting constraints on student learning brought about by instructional design and its associated cognitive load and overload,

and that Cognitive Load Theory can suggest effective ways of how to reduce and ease these. Further, multimedia does appear likely to confer significant advantages for learning and understanding English Literature texts and for associated GCSE outcomes and does so disproportionately more so than traditional established (non-computer multimedia) teaching and learning resources.

In the next chapter (Chapter 6) conclusions are drawn about the relationship between the use of different instructional resources and student learning as illuminated by the empirical investigations made using Learning Styles and Cognitive Load Theory in Chapters 4 and 5. These conclusions are discussed in light of the literature review in Chapter 2 and the research questions.

Chapter 6 – Conclusion and implications

6.1 Introduction

The end of Chapter 1 concluded by posing three main questions and a number of sub-questions:

1. What are the educational implications of using computers and multimedia software in schools that have been identified in published research?

2. Can multimedia software enhance student achievement at GCSE level?
    a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?
    b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

3. What are the implications for theory, research and practice of using multimedia software as an aid to promoting learning in students studying English Literature for GCSE examinations?
    a) What are the implications for practicing teachers in secondary schools?
    b) What are the implications for educational theory?
    c) What are the implications for research?

This chapter will present a summary of the findings from this study in relation to each of these questions and sub-questions in turn. For each of these the main issues will be identified and the discussion will reflect on what can be concluded from the present work.

6.2 Policy, expectations, pedagogy and effectiveness : A perspective from the literature

This section will summarise the discussion of the first research question:

> What are the educational implications of using computers and multimedia software in schools that have been identified in published research?

This section starts with an outline of the origins of the study and then proceeds to summarise the analysis of the policy and expectations surrounding the adoption of ICT in schools. The discussion then turns to what key issues can be gleaned from research on the effectiveness of ICT use in schools and their associated implications for pedagogy.

In part this study owes its origins to the tensions found in education from 1970s onwards between a desire for student centred learning and the more utilitarian and economic expectations for ICT use embedded within the National Curriculum. My experience of teacher training and with computer applications such as *Zork!* had convinced me of the superiority of experiential learning and a more student centred approach for capitalising on the opportunities offered by ICT. The software application used in the present study therefore grew from a desire to implement such approaches to achieve many of key objectives within the study of GCE (later GCSE) English Literature texts such as understanding dramatic structure; insight into character; appreciation of dramatic relationships; awareness of structural themes and images; understanding of historical or social context; and an appreciation of how such elements interact to create meaning and reveal insight into the human condition.

Many government funding initiatives in the 1980s and 1990s provided ICT equipment and infrastructure for schools but fundamental educational change faltered in the face of the failure to sufficiently address teachers' concerns about training, to clearly identify the educational advantages of ICT use over traditional approaches, to operationalise the concept of 'effectiveness' when applied to ICT, to take due note of concerns raised in research and to pay sufficient regard to the influence of existing teacher approaches to classroom pedagogy. With the benefit of hindsight it seems likely that these factors between them created a

climate in which the use of ICT to promote student centred experiential learning was more problematic for teachers to adopt.

The literature from the 1980s onwards identified a number of important issues with regard to research methodology and practice that are relevant when applying multimedia use to learning. First is the need to avoid creating unrealistic expectations from the presence of physical resources such as computers in schools and to recognise the limited benefit that may be gained from simply showing teachers how to operate them. Second is to accept the value of using controlled experimental studies such as the present one over those relying on impression or opinion gathering, especially from those enthusiasts (at times including governments) dwelling unduly on the potential or promise of ICT rather than upon evidence. For this reason the present study sought to locate itself within school English departments where there were few preconceived notions or established practice with regard to ICT use. Third is the need to avoid the sometimes unhelpful nature of short duration, small scale studies which do not compare ICT and non-ICT use in similar settings and where improvements in educational outputs are not clearly identified, where effect sizes not reported and where ‘effectiveness’ remains vague or unspecified. Fourth is the need to take due account of the relationship between technology use and the pedagogical approaches of teachers and be able to demonstrate where ICT confers benefit over established approaches to learning and teaching. Finally the research literature identifies the need to recognise the important role that teachers' beliefs about the nature of student learning play in mediating the uptake of any new resource or change in education; including how the behaviour of teachers is influenced by the expectations of key audiences, the attitudes of school senior management and the external assessment structures and inspection regimes within which they must work and are held accountable.

Studies identifying bivariate relationships between ICT use and educationally desirable outcomes have been criticised for confounding correlation with causation and for failing to adopt adequate controls. A number of findings from studies that have reported strong relationships between ICT use and educational gains have been questioned because of their small sample sizes, failure to include valid control groups, failure to compare students appropriately and for the absence of the use of controls for omitted variables. Ofsted reports

have at times claimed educational benefits from information and communication technology use which on closer inspection appear to be indistinguishable from outcomes that are mainly associated with skilled teaching, or with outcomes equally achievable without the use of ICT. Over the last ten years writers have tended increasingly to echo the views of educationalists influential around the 1970s in advocating a more even balance between direct instruction and an individualised, student-centred, experiential pedagogy. The present study has sought to minimise or avoid such difficulties by the adoption of rigorous analysis, the use of adequate sample sizes and appropriate controls and an ecologically valid approach to compare the learning gains of groups making use of multimedia with comparable groups that did not.

Multimedia has been argued to be an especially useful vehicle for promoting a more varied approach to instruction that goes beyond just the presentation of content because its dynamic nature is able to accommodate changing individual approaches to material, to offer varied level of challenge and to facilitate switching of area of focus as required by the learner. Because it is also able to offer flexibility of pace and access to different presentational formats and media, multimedia is also often regarded as useful for developing phenomenographic and constructivist pedagogy that will encourage learners to interact with and critically evaluate content by drawing upon their individual objectives and existing knowledge and perceptions. However there are some concerns that the availability of so much flexibility may lead to superficial and damaging habits of 'grazing' content as is sometimes seen when students search the web with a browser. Some surveys of commercial multimedia applications have also found many of them to be devoid of direct instructional approaches to content that might protect against superficial engagement, heightening concerns that there should be more study of multimedia use that is informed by teacher pedagogy, research findings and educational theory. The present study sought to take account of such concerns in both the design of the multimedia software and in that of the methodology for the study itself.

Because the use of learning styles and the application of cognitive load theory have been proposed as important ways in which the kind of research outlined above could be pursued, a consideration of the use of these also was incorporated into the study design. The following two sections therefore turns to

the second research question about whether multimedia software can enhance student achievement at GCSE level.

6.3 Learning Styles Theory and Cognitive Load Theory

This and the following section summarise the findings from the present study regarding whether multimedia software seemed likely to be able to enhance student achievement at GCSE level. Two particular approaches have been explored in the present study and findings from this are summarised under the two research question sub-headings:

a) Do students have preferred styles of learning that should be incorporated into the design and use of multimedia software?

b) Does multimedia software seem likely to confer advantages for GCSE examination outcomes when compared to the use of more established or traditional classroom teaching and learning resources?

Learning styles theory proposes that the reason some material is more difficult to learn than other material has a lot to do with each individual's habitual approach to learning or their 'learning style'. Learning style theory argues that if the provision of instructional resources took account of individual learning style, better learning would always result. According to this view, learning can therefore best be facilitated by taking into account an individual's learning style when designing or presenting them with any learning resource. The instruments developed by Kolb (1984, 2005) and Honey and Mumford (1992) - the LSI-2 and the LSQ, respectively, as used in this study - are intended to reveal each individual's strongest customary way of learning from the four broad approaches or styles that they propose exist:

Theorist	-	Abstract Conceptualising
Activist	-	Concrete Experience
Reflector	-	Reflective Observation
Pragmatist	-	Active Experimentation

The present study explored whether the LSI-2 and the LSQ produced comparable outputs for a sample of secondary (K11-K13) students in the UK

and whether empirical evidence could be found for the four learning styles. If this proved to be the case the intention was to include these measures in the trail of the multimedia software used in the present study to find out whether these instruments offered benefits for improving individualised instruction in the context of English literature.

In contrast to learning styles theory, cognitive load theory proposes that the reason why some material is harder to learn than other material is due to the way human memory uses short term memory ('working' memory) and long term memory ('storage' memory). Short term memory is seen as having limited capacity and is used to create and process complex cognitive constructs, or schemas, which are stored in long term memory, which is seen as having almost unlimited capacity.

According to cognitive load theory, creating new schemas or retrieving existing ones from long term memory and using them in short term memory therefore allows us to address complex material (by breaking some of it down into 'chunks') in a way that would otherwise make the material impossible to process from first principles because this would overwhelm the limited capacity of short term memory. Without the use of appropriate schemas, complex and difficult material may create a 'cognitive load' that is too great and we would find the material too difficult to understand or learn. The use of any particular schema is thought to become somewhat automated with repeated use; learning is thereby made more efficient and the ability of the individual to understand and learn conceptually complex, difficult content also more automatic.

Research into the application of cognitive load theory has concluded that a number of factors can affect the degree and type of cognitive load on a learner for different reasons:

the presence of existing schema	-	because this will affect the *germane cognitive load* that is imposed during constructing, processing and 'automating' schemas
prior learning	-	because this determines the number / complexity of existing relevant schemas
instructional design	-	because poor design often makes material more difficult to process and so can create higher *extraneous cognitive load*
the inherent complexity or difficulty of the material	-	because it may be very difficult to reduce this and this may create unavoidably high levels of *intrinsic cognitive load*

The following section summarises the findings from the two empirical studies conducted as part of the present work to explore these two different approaches.

6.4 Empirical studies and findings

From the four secondary schools from North-East of England that were involved in the present study, seven hundred and eighty eight participants were recruited from sixteen classes, taught by a total of eighteen different teachers. Each of these four schools had been deemed to be 'highly successful' as a result of their most recent Ofsted inspection. In particular, Ofsted inspectors had noted that teachers in these schools were highly skilled at identifying and meeting students' individual learning needs. These schools made significant use of two particular instruments for measuring learning styles - Kolb's LSI-2 (Kolb, 1984) and Honey and Mumford's LSQ (Honey & Mumford, 1992) - and also made widespread use of the outputs from these to inform learning and teaching. The

English departments in these schools had in common a willingness to be involved in the study but had relatively limited experience of using ICT with their students and no experience at all of multimedia software such as that used in the present study.

No evidence was found from this part of the study that should allow the teachers in the four schools to feel confident that using the two learning styles instruments would be of benefit to them or their students for informing their learning or teaching of English in the secondary curriculum. Despite using similar descriptors for their respective classifications, Kolb's LSI-2 and Honey and Mumford's LSQ did not create similar classifications and no systematic or statistically significant correlation between the outputs from these instruments was found. Given that both instruments also failed to display sufficient internal reliability to inspire confidence or to sufficiently map outputs to their theoretical constructs, it became clear that it would not be possible to draw on the findings from these instruments to reflect on, or understand more fully, much earlier observations of student behaviour when using the *Zork!* software, or to make use of them when progressing to the next stage of the study using the English Literature multimedia software.

Despite these outcomes many of the teachers involved in the project continued to maintain that individuals have preferred approaches to learning; a view based on their own observations and experience. Teachers also saw merit in the LSI-2 and LSQ as a way to get students thinking about how they learned, although there was little evidence that these teachers actually made any structured use of such thinking on the part of their students. These teachers reported that they routinely 'matched' the preferred approaches of individual students to learning against their own teaching behaviour but it seemed clear that whilst they each had their own teaching 'style' they seemed to use this same style for much of their practice and therefore had a fairly standardised approach to classroom delivery for all their students.

For the teachers and schools in this study the LSQ and LSI-2 possess high face validity and this is the main reason why they make extensive use of them to inform pedagogy and influence their assessment strategies. In these schools the judgments of external inspectors clearly also contributed to the likely continued use of learning styles by teachers, as did the requirements of school policy, the

prescriptive curriculum with which they were required to work and their lack of familiarity with research critiquing learning styles; the latter might have allowed them a more measured view of learning styles and the instruments developed for measuring them - in particular those devised by Kolb and Honey and Mumford. However, the outputs from learning style instruments had their greatest utility for teachers in these schools in ‘fending off’ school managers and addressing the perceived agenda of Ofsted inspectors, as well as for deflecting what were often seen by teachers as management ‘hobby-horses’ or government policy fads. The continued use of learning styles was therefore made highly likely as a result of the interaction of a number of vectors; of face validity; external inspection; professional accountability; school policy; initial training; and teachers' current lack of familiarity with published research.

The present study therefore turned its attention to Cognitive Load theory as a means of exploring the outcomes from the use of the multimedia software when compared to those associated with resources usually employed by the English teachers in the four schools. Comparable groups for each teacher were used over approximately their first half-term of study of Shakespeare's *Macbeth* where the experimental group used the multimedia software in addition to their normal classes and 'matched' control groups did not. Scores from a pre- and post-intervention test of knowledge and understanding (of *Macbeth*) revealed that whilst there were variations within and between schools in the amounts by which students' scores had increased over the period of the intervention, when results were controlled for prior learning the use of the multimedia resource in the four schools improved scores of knowledge and understanding in English Literature substantially beyond those achieved without the resource.

In these four schools there was a large and statistically significant 'multimedia effect' in evidence in the increases in the scores for knowledge and understanding but these relative gains did not appear to be directly related to the intrinsic ability of students. There was a highly statistically significant difference between males and females in the experimental group for the overall difference between pre-test and post-test scores and for the relative measure of learning gain in knowledge and understanding, with females achieving larger gains relative to males in both the one all-female school and the other three mixed-sex schools. With the exception of one school, this pattern was repeated in the control groups also.

However, the multimedia intervention exerted a stronger effect on the post-test scores than either the sex of the student or the school they attended, despite males and females having comparable starting points. The use of the multimedia resource was a stronger predictor of gains in knowledge and understanding than either the sex of the student or the school at which they studied. The use of multimedia was strongly associated with increased performance in important areas of learning most relevant for success in external examinations in English Literature at GCSE. The effect sizes and statistically significant differences found between the control groups and the experimental groups were notable, being equivalent on average to around one grade difference in GCSE results.

It is clear that for the participants in the present study cognitive load was eased by the use of multimedia, and that the greatest easing was where multimedia were integrated with animation, audio, explanation, and background analysis. These outcomes indicate that Cognitive Load Theory can offer both a useful explanation for the findings from the use of multimedia and that it can also assist the teachers of English Literature in these schools in optimising the learning gains associated with their teaching, particularly in terms of the resources that they use. This is in contrast to Learning Styles theory which, as was demonstrated in Chapter 4, was unable to provide reliable guidance for pedagogy or resource use in this way. The present study indicates that intrinsic cognitive load in English Literature teaching and learning can be rendered more manageable by the use of integrated and advanced multimedia that move beyond the display of only text to using animation, background materials, and voice-over commentaries.

In comparison to the other (non-multimedia) resources used, including those customarily employed by the teachers in the four schools, the multimedia also produced lower *extraneous* cognitive load on working memory, which is the load created as a result of unnecessary processing caused by instructional design and, if it is too high, is unhelpful for learning. The findings here also show that, because of the above outcomes, the multimedia resource was helpful in moderating the effects of the *intrinsic* cognitive load attributable to the inherent complexity and difficulty of the material to be learned (*Macbeth*) by offering learners who each had relatively little prior knowledge of this literary work the

integrated resources that Cognitive Load Theory predicts will be most helpful in facilitating the creation of the schema required for learning.

The findings from the present study suggest that multimedia can have a positive influence on student achievement and that it can have a stronger positive influence than other resources, especially those that are likely to encourage a split-attention effect. The teachers in the four schools could therefore make use of Cognitive Load Theory to improve the learning of their students, particularly in the teaching and learning of inherently complex and challenging material like Shakespeare's *Macbeth*. In the present study Cognitive Load Theory has been shown to be more successful than Learning Styles Theory for understanding the relationship between the use of different resources and learning and has proved successful in showing how the use of active and interactive multimedia techniques can be valuable in easing that degree of cognitive load which is counter-productive to effective and efficient learning. This present study also suggests that Cognitive Load Theory can make a significant contribution to understanding the limiting constraints on student learning brought about by instructional design and its associated cognitive load and overload, and that Cognitive Load Theory can suggest effective ways of how to optimise these. Further, multimedia does appear likely to confer significant advantages for learning and understanding English Literature texts and for associated GCSE outcomes and does so disproportionately more so than traditional established (non-computer multimedia) teaching and learning resources.

6.5 Contribution to knowledge

Although there are limitations to this study that affect the conclusions we may safely draw (see 'limitations' below) it has made a contribution to knowledge in several respects and contains a number of important features and findings that are significant for our understanding of the interaction between multimedia technology, pedagogy, learning and teaching.

Within four secondary schools in the North-east of England praised in government inspections as being highly successful, the present study has identified what appear to be some of the most common difficulties and issues faced by teachers of GCSE-level English courses in implementing evidence-based approaches to instruction and resource use.

Even though each of the four schools in this study had as an important part of their espoused ethos the promotion of an individualised approach to learning; this study identified how a number of related other factors exerted pressures and constraints upon teachers' pedagogy, their planning of instructional activity and upon their general classroom practice for promoting individualised learning. In particular, this study identified how the teachers who were involved perceived - and felt compelled to respond to - pressures on their behaviour exerted by educational practices which possess strong face validity; the perceived agendas of external inspectors; the way their professional accountability was constructed; school policy; and how their current pedagogy was influenced by their initial training and by their awareness of relevant research.

This study is the first controlled empirical and extended investigation of its kind into the learning gains attributable to multimedia use and the likely impact of this on GCSE examination performance in the context of English literature learning and teaching. Earlier studies of multimedia use and cognitive load theory have tended to focus on relatively narrow learning objectives that tended to be associated with more strongly bounded scenarios for learner mastery with older participants (typically college or university students) such as learning about the mechanisms supporting the formation of lightning, the fuel ignition cycle in the internal combustion engine, the relationship between Earth's rotation and the location of time zones or the current medical procedure for administering cardiopulmonary resuscitation (CPR).

In contrast, the present study applies a rigorous comparative empirical approach to a scenario where learners are exposed to conceptually demanding and complex instructional content and by learning this are required to develop and articulate sophisticated understandings of intellectually mature, challenging and sometimes highly nuanced portrayals of the human condition - in this case within their study of Shakespeare's *Macbeth*. Earlier studies of multimedia use have tended to focus on conceptually simple content, have been of short duration and have often not been able to claim the high ecological validity obtained in the present study by virtue of its location within functioning schools over extended periods of curriculum time in non-artificial and high-stakes learning programmes.

Against the contested background of prior research into learning styles, this study demonstrated that two of the main instruments and theoretical approaches for measuring and conceptualising learning styles were unable to demonstrate sufficient validity or reliability with the selected sample and in the chosen context to warrant their continued use. Further, these instruments were unable to produce similar outputs from the same sample, despite their strong similarities at the theoretical level. These instruments are used in many organisations - most commonly those in adult training and education or industry - but are increasingly being deployed in the context of compulsory education. Their unreliability and inaccuracy are therefore of significant importance in the setting of the present study, especially as learning styles appear to influence teacher pedagogy and because schools such as those in the present study recognise that their use is esteemed by external audiences to which they are accountable.

In contrast to two approaches to Learning Styles Theory and their associated instrumentation, this study demonstrated the contribution that can be made by Cognitive Load Theory to our understanding of the relationship between instructional content, resource design and educational performance. This study has shown how Cognitive Load Theory could be used by teachers to improve the learning of their students, particularly of inherently complex and challenging material. Cognitive Load Theory has also been shown to be more successful than Learning Styles Theory for understanding the relationship between educational resources and learning and how multimedia software can be valuable promoting more effective and efficient learning

The present study also demonstrated the value of the multimedia resource in promoting learning gains relevant to GCSE examination performance and in addressing the differences customarily now found between the performance of boys and girls. Statistically significant differences were found within and between the experimental and control groups for sex, with females typically outperforming males, in line with national trends across many subjects studied at GCSE level, but especially in English. However, the multimedia intervention exerted a stronger effect on the post-test scores than either the sex of the student or the school that they attended, and the multimedia showed the greatest difference and distance between the mean scores for other kinds of resource for all the other factors. In other words, the use of multimedia was associated with the strongest differences in learning of all those found. The use

of multimedia may therefore be of value in overriding the persistent 'background' effect being expressed through differences in GCSE performance by sex.

The use of the multimedia resource in the four schools improved scores in the field of knowledge and understanding in English Literature substantially beyond those achieved without the resource. Using the multimedia software made a statistically significant difference to the cognitive load experienced by students, easing it for both the experimental and control groups when compared to the cognitive load associated with other resources (Chapter 5, section 5.3.3). The present study has shown that the use of multimedia software can make a significant contribution to improvements in learning - over and above those from more traditional non-multimedia resources - and perhaps especially when its design, operation and content are informed by effective teaching practices drawn from experience as advised by a number of researchers and discussed in the literature review (Chapter 2).

6.6 Limitations of the study and recommendations for future research

Caution has to be exercised in interpreting the results found from using the multimedia software in the chosen context. Although the software was developed from experience gained from extensive successful practice over many years it was not designed in light of - or explicitly to test - either Learning Styles Theory or Cognitive Load Theory. However, this is equally true for many other studies of the educational application of technology and the above reservation could be countered by the point that all educational research should be able to be applied in this way to demonstrate its usefulness for understanding effective practice. Nonetheless, these issues do limit the degree to which the present study may be regarded as a true experiment but also highlight the degree to which this may ever be attainable within an ecologically valid context where the availability and use of computers was randomly divided between a treatment group that has computer access and a control group that does not have computer access.

Additionally, the schools used in the present study may not be typical. The four schools were selected using a process that identified a particular sub group of schools, as set out in the methodology (Chapter 3, section 3.5). In addition to the limits to generalisability due to the sample size, the selection process for

identifying the four schools may limit the relevance of the present study for schools which did not match these criteria and may therefore have very different internal dynamics, students, resources and other factors that may be relevant to the outcomes reported here.

Within the findings from the present study, there were between-group differences in the gains in knowledge and understanding in the four schools in terms of the control groups and in terms of the experimental groups, and this suggests that the influence of cognitive load resides not only in external matters, such as the teaching and learning materials used (though clearly they made a significant difference here) or the types of materials contained within multimedia (which the tables in Chapter 5 show), but that it also resides within the learners.

The ease of learning with any given educational resource may therefore be in part due to the resource itself, or to the prior learning of the individual, but also to a host of other subjective, personal, or biographical factors such as student motivation, student-teacher interaction, or student-student interaction, and these other factors cannot be ruled out as having no bearing on the results found, and it is not possible to be certain that cognitive load is a feature of only “cognitive” processes. Further research therefore needs to be done on what these other factors may be and what may be the relative weight of their influences on outcomes.

Further, though controls were exerted wherever possible between the control and experimental groups, this was a quasi-experiment study and, being a field experiment, it was not therefore possible to hold some variables constant, that is, to have complete controls in place. For example, it was not always possible to match exactly the control and experimental groups (e.g., one school was single-sex), and random allocation was not possible even though several steps were taken to ensure matching between the control and experimental groups, as discussed in Chapter 5. Further research with fuller controls would be valuable here, although caution will be needed to ensure that any outcomes from strictly controlled experimental studies can be generalised to a wider population. For example, if greater controls are imposed these may severely distort the equivalence between the experimental setting and the contexts found in actual classrooms in schools and in such a case the outcomes of the experiment, although providing more scientifically controlled results, may risk being seen as

far removed from everyday experience and therefore as less valuable in understanding and explaining how Cognitive Load Theory can help in explaining and understanding the relationships between resources, learning and teaching in real classrooms.

Finally, the present study operated on largely a 'black box' situation and is concerned largely with input and output measures. This kind of study does not therefore tell us about the effects of process variables and of variables within the learners (and, as discussed above, subjective factors are very likely to be relevant in analyses of cognitive load), and these may be important. Hence, the study in the four schools raises questions for further research, especially concerning those process variables and learner-related variables that could be exerting an influence on the situation, such as the motivation or interest of individual students, the interaction between the teachers and student or interactions between students in the various groups, which could be researched, for example, through observational studies.

For the above reasons it would be unwise to generalise from the present work. Also, there is also a growing trend for teacher education to be located more within the professional workplace which has implications for what may be recommended within the research sub-questions used here. However, whilst acknowledging these factors, the general recommendations below may perhaps be cautiously offered from the findings of the present study, in line with research question 3:

> What are the implications for theory, research and practice of using multimedia software as an aid to promoting learning in students studying English Literature for GCSE examinations?

a) What are the implications for practicing teachers in secondary schools?
b) What are the implications for educational theory?
c) What are the implications for research?

6.6.1 What are the implications for practicing teachers in secondary schools?

Especial care is required from teachers when considering proposals for educational practice that have high face validity, as the present study has demonstrated that this factor may tend to lower the level of critical scrutiny to which such proposals are exposed in the minds of practitioners, policy makers, parents and other important educational audiences and have consequences for practice within accountability mechanisms. Insufficiently critical examination of such proposals may also risk leading to unwarranted use.

Following from this, changes to educational practice should be invoked only when demonstrable advantages over existing practice can be evidenced that will improve educational outcomes.

Given the experiences consistently reported as highly typical by teachers in the present study, it may be helpful for school accountability to be more securely located within the context of research and for teacher practice be more research informed. Similarly, it would seem to be important for student learning that an appropriately critical view of commercial, political and speculative propositions about educational practice be securely retained by teachers throughout their professional lives.

It may be useful for teachers to closely monitor the relationship between the use of educational resources and individual progress in learning - and to encourage students to also take an active part in this process.

Teachers should consider making more use of multimedia software that has been developed in ways similar to those for the application used in the present study and not feel deterred by any lack of training or ICT competence, or by their preferences for a particular pedagogical approach, as their existing skills and experience are likely to continue to be the most important determining factor in the educational progress of their students.

Within this, the present study may corroborate prior research suggesting that an optimal level of ICT use for learning may exist and this could usefully be monitored for different contexts.

6.6.2 What are the implications for educational theory?

There remains the need for theoretical propositions about the configuration or process of teaching and especially the adoption of particular methods, models or technologies to continue to be rigorously investigated in an attempt to refine theoretical models of learning and the instruments proposed for evaluating these.

It may also be the case that educational theory developed from and applied within particular contexts may not generalise to others, despite assertions by advocates that this should be the case. The two models within Learning Styles Theory and their associated instrumentation that are explored in the present study are argued to generalise when referenced against target populations but this is contested in both the wider research and in the present study. The implication here would seem to be that there still remains much work to do in developing sufficiently nuanced and operationalised theoretical models within learning styles to permit application. In contrast Cognitive Load Theory appears to be a more successfully grounded model with more reliable instrumentation and for the time being at least holds greater promise for understanding the relationship between educational resource use and learning gains.

6.6.3 What are the implications for research?

There would appear to be merit in broadening the public awareness of educational research and in deepening the public understanding of its outputs so as to better inform public debate about educational policy and practice.

Drawing on the observations of teachers in the present study and their impressions of the thinking of their colleagues in other schools, there is a need to promote the closer integration of research and practice. Perhaps this may be achieved by the more vigorous promotion of teaching as a research led profession; perhaps by an insistence that educational initiatives be subject to stronger support from prior scientific research; or possibly through the more rigorous evaluation of educational initiatives that was so notably lacking from government policy in the 1980s.

Research into the use of multimedia software aimed at improving educational attainment should continue and, in particular, the present study should be replicated in different settings in an attempt to establish the generalisability of the findings reported here and to explore further the contribution that Cognitive Load Theory may make to understanding the relationship between particular resource use, the different kinds of cognitive load created and the relationship of these to particular learning gains when compared to other resources.

Finally, efforts should continue in this way to bridge the historical gulf in the UK that appears to have existed for so long between educational research and educational practice, as discussed in the literature review (Chapter 2).

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Appendix 1

Kolb's Learning Style Inventory LSI-2 (1985)

Instructions given to participants:

Look at the four statements in each row and decide how they relate to you.
Score each of the statements – please do not leave any boxes empty.

There are no right or wrong answers.

Write '4' in the box next to the ending which you think is the most like you, '3' for the one that is next like you … and '1' for the one which you find the least like you.

For example: While learning, I am: 4. happy 1. quick 2. logical 3. careful.

This example would mean that you thought that, while you are learning, mostly you are 'happy', then next in order would be 'careful', then 'logical' and that least like you is 'quick'.

Remember:
4 = most like me
3 = more like me
2 = less like me
1 = least like me

NOTE:

Next to each of the 12 questions are four blocks of responses. Blocks in the instrument used in the present study (shown here) are rearranged from the original instrument to address a possible positional response set bias.

Each of the blocks next to every question represents one of the four learning styles. In the original instrument each column of blocks contained items for only one of the four learning styles, ordered as: *concrete experience (CE)*; *reflective observation (RO)*; *abstract conceptualisation (AC)*; and *active experimentation (AE)*.

For illustration and clarification here (but not present in the version used), blocks have been colour-coded:

CE	RO	AC	AE

1	When I learn:	☐	I like to deal with my feelings	☐	I like to think about ideas.	☐	I like to be doing things.	☐	I like to watch and listen.
2	I learn best when:	☐	I work hard to get things done.	☐	I rely on logical thinking.	☐	I listen and watch carefully.	☐	I use my hunches and feelings.
3	When I am learning:	☐	I am quiet and reserved.	☐	I am responsible about things.	☐	I have strong feelings and reactions.	☐	I tend to reason things out.
4	I learn by:	☐	doing.	☐	watching.	☐	thinking.	☐	feelings.
5	When I learn:	☐	I am open to new experiences.	☐	I like to try things out.	☐	I like to analyze things, break them down into parts.	☐	I look at all sides of issues.
6	When I am learning:	☐	I am a logical person.	☐	I am an intuitive person.	☐	I am an observing person.	☐	I am an active person.
7	I learn from:	☐	a chance to try out and practice.	☐	observation.	☐	personal relationships.	☐	rational theories.
8	When I learn:	☐	I take my time before acting.	☐	I like ideas and theories.	☐	I feel personally involved in things.	☐	I like to see the results from my work.
9	I learn best when:	☐	I rely on my ideas.	☐	I rely on my feelings.	☐	I can try things out for myself.	☐	I rely on my own observations.
10	When I am learning:	☐	I am a rational person.	☐	I am a reserved person.	☐	I am a responsible person.	☐	I am an accepting person.
11	When I learn:	☐	I get involved.	☐	I like to be active.	☐	I like to observe.	☐	I evaluate things.
12	I learn best when:	☐	I am careful.	☐	I am receptive and open-minded.	☐	I analyze ideas.	☐	I am practical.

Appendix 2

Honey and Mumford's Learning Style Questionnaire (LSQ)

Instructions given to participants:

Below are some sentences about different kinds of people.
Please carefully read each sentence and:

If you think a sentence is true about you, put a cross in the box next to it.
If you think a sentence is not true about you, leave that box empty.

Remember: only put a cross in a box if you think that sentence is true about you.

1. ☐ I have strong beliefs about what is right and wrong, good and bad.
2. ☐ I often do things without thinking.
3. ☐ I tend to solve problems using a step-by-step approach.
4. ☐ I think rules and regulations often get in the way.
5. ☐ I have a reputation for saying what I think, simply and directly.
6. ☐ I often find that doing what my feelings tell me is just as good as doing something only after I have thought about it carefully.
7. ☐ I like the sort of work where I have time to prepare things and do things very thoroughly.
8. ☐ I regularly ask people about the things they are taking for granted.
9. ☐ What matters most is whether something works in practice.
10. ☐ I am always looking for new things to try.
11. ☐ When I hear about new ideas or new ways of doing things, I always start thinking about how to try them out.
12. ☐ I am strict with myself about things like watching what I eat, taking regular exercise, sticking to a routine, etc.
13. ☐ I take pride in doing a job thoroughly.
14. ☐ I get on best with logical people and less well with people who act on the spur of the moment.
15. ☐ I am always careful not to jump to conclusions about things.
16. ☐ I like to reach a decision carefully after thinking about lots of alternatives.
17. ☐ I'm attracted more to unusual ideas than to practical ideas.
18. ☐ I don't like disorganised things and prefer things to be tidy.
19. ☐ When I do things I follow the rules, as long as they don't get in my way.
20. ☐ I like to do things that fit into my beliefs about how people should behave.

21. ☐ In discussions I like to get straight to the point.
22. ☐ I usually don't have close friendships with people at school.
23. ☐ I really enjoy tackling something new and different.
24. ☐ I enjoy fun-loving, spontaneous people.
25. ☐ I pay very careful attention to detail before coming to a conclusion.
26. ☐ I find it difficult to produce ideas on impulse.
27. ☐ I believe in coming to the point immediately.
28. ☐ I prefer not to jump to conclusions.
29. ☐ I like to have as many different bits of information as possible – the more there is to think over the better.
30. ☐ People who don't take things seriously enough usually irritate me.
31. ☐ I listen to other people's opinions before putting my own point of view forward.
32. ☐ I tend to be open about how I am feeling.
33. ☐ In discussions I enjoy watching other people trying to make the best points.
34. ☐ I like to do things on the spur of the moment, rather than plan things out in advance.
35. ☐ I like to know about different ways of planning and organising things.
36. ☐ It worries me if I have to rush a piece of work to meet a tight deadline.
37. ☐ I tend to judge people's ideas on how practical they are.
38. ☐ Quiet, thoughtful people tend to make me feel uncomfortable.
39. ☐ I often get irritated by people who want to rush things.
40. ☐ It is more important to enjoy the present moment than to think about the past or the future.
41. ☐ Decisions based on careful thinking are better than those based on instinct.
42. ☐ I tend to be a perfectionist.
43. ☐ In discussions I usually produce lots of spontaneous ideas.
44. ☐ In discussions I put forward practical ideas.
45. ☐ More often than not, rules are there to be broken.
46. ☐ I prefer to stand back from a situation and think about all the different ways of looking at it.
47. ☐ I can often see faults and weaknesses in other people's arguments.
48. ☐ On balance, I talk more than I listen.
49. ☐ I can often see better, more practical ways of getting things done.
50. ☐ I think written reports should be short and to the point.
51. ☐ I believe that logical thinking should always win discussions.

52. ☐ I tend to discuss specific things with people, rather than have general social conversations with them.
53. ☐ I like practical people, rather than people who just like to think about things.
54. ☐ In discussions, I get impatient with people who don't stick to the point.
55. ☐ If I have some written work to do, I tend to produce lots of different versions before settling on the final one.
56. ☐ I am keen to try things out to see if they work in practice.
57. ☐ I am keen to reach answers using a logical, thought-out approach.
58. ☐ I enjoy being the one that talks a lot.
59. ☐ In discussions, I often find that I am the practical person, keeping people to the point and avoiding silly ideas.
60. ☐ I like to think about lots of alternatives before making up my mind.
61. ☐ In discussions with people, I often find that I am the most calm and thoughtful person.
62. ☐ In discussions, I'm more likely to keep quiet than to take the lead and do most of the talking.
63. ☐ I like to be able to think about how what I do next will affect the future.
64. ☐ When things go wrong, I am happy to shrug it off and 'put it down to experience'.
65. ☐ I tend to reject wild, spontaneous ideas because they are not practical.
66. ☐ It's best to think carefully before taking action.
67. ☐ On balance, I do the listening rather than the talking.
68. ☐ I tend to be tough on people who find it difficult to adopt a logical approach.
69. ☐ Most times I believe that it doesn't matter what you do so long as things come out right in the end.
70. ☐ I don't mind hurting people's feelings so long as the job gets done.
71. ☐ I find that having to have clear aims and plans gets in my way.
72. ☐ I'm usually one of the people who puts life into a party.
73. ☐ I do whatever is needed to get the job done.
74. ☐ I quickly get bored with routine, detailed work.
75. ☐ I like to know the ideas and theories that explain how things work and why things happen.
76. ☐ I am always interested to find out what other people think.
77. ☐ I like lessons and meetings to be run in an organised way, following a plan.
78. ☐ I avoid topics that are vague, or are just about people's opinions.
79. ☐ I enjoy the drama and excitement of a crisis situation.
80. ☐ People often find me insensitive to their feelings.

(sum of item values for questions under column headings):

Activist	**Reflector**	**Theorist**	**Pragmatist**
2	7	1	5
4	13	3	9
6	15	8	11
10	16	12	19
17	25	14	21
23	28	18	27
24	29	20	35
32	31	22	37
34	33	26	44
38	36	30	49
40	39	42	50
43	41	47	53
45	46	51	54
48	52	57	56
58	55	61	59
64	60	63	65
71	62	68	69
72	66	75	70
74	67	77	73
79	76	78	80

Appendix 3

Questionnaire for scoring resources

Helping you with your learning.

In these questions we want to know what kinds of things help you most in your learning. You will need to look at the Sample Book to answer these questions.

Each set of questions is about one of the pages in the Sample Book.

Please turn to the page in the Sample Book and look at it carefully before answering the questions for that page.

Do not worry if the questions are about a play or a book that you have not read. The pages in the Sample Book are only meant to be examples.

Imagine how helpful you *would* find the things in the Sample Book if they *were* about a book or play you have read or studied.

Remember: There are no wrong answers. We want to know what helps you.

Turn to Page 1 in the Sample Book

This is a page from a Study and Examination Revision Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful is it to have a lot of information handy on one page like this?	☐	☐	☐	☐	☐
How helpful are things like the 'Story in Brief' and the 'Story Sub-Plots' sections?	☐	☐	☐	☐	☐
How helpful are things like the 'Structural Elements' section, that summarise the dramatic structure of the play or book?	☐	☐	☐	☐	☐
How helpful are things like the 'Language and Poetry' section, that summarise the way language is used in the play?	☐	☐	☐	☐	☐
How helful are sections like the 'Background Elements' section, that tell you about important things that were happening around the time when the play or book was written?	☐	☐	☐	☐	☐

Turn to Page 2

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are short summaries of different characters, like these?	☐	☐	☐	☐	☐
How helpful is it to have lists of quotations for different characters, like these?	☐	☐	☐	☐	☐
How helpful is it to have a lot of information collected together on one page, like this?	☐	☐	☐	☐	☐
How helpful is the feedback you get from these types of questions? ('feedback' is what the computer tells you when you pick an answer)	☐	☐	☐	☐	☐

Turn to Page 3

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful is it to have longer summaries for each character, like these?	☐	☐	☐	☐	☐
How helpful is it to have things about the themes and ideas in the book or play, listed like this with places in the book where you can find more information?	☐	☐	☐	☐	☐
How helpful would it be to have this kind of information spread out over several pages rather than together in one place, like it is here?	☐	☐	☐	☐	☐
How helpful would it be to have pictures and drawings included on pages like these?	☐	☐	☐	☐	☐

Turn to Page 4

This is a page from a Revision Guide or Study Guide about different characters in a play

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these kind of details for understanding the different characters?	☐	☐	☐	☐	☐
How helpful is it to have the references (the things in brackets) for the book or play so you know where to find events?	☐	☐	☐	☐	☐
How helpful is it to have a 'breakdown' of each character, like these?	☐	☐	☐	☐	☐

Turn to Page 5

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are maps like these for increasing your understanding of where things happen in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your enjoyment of the book?	☐	☐	☐	☐	☐

Turn to Page 6

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are pictures like these?	☐	☐	☐	☐	☐
How helpful are things like the 'checkpoint' boxes?	☐	☐	☐	☐	☐
How helpful are things like the 'glossary' box?	☐	☐	☐	☐	☐
How helpful are things like the numbered 'bullet-points' at the start of a section like the one here about the story?	☐	☐	☐	☐	☐

Turn to Page 7

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are things like the 'examiner's secret', on this page?	☐	☐	☐	☐	☐
How helpful are drawings like the one here, that is about who says what and about whom?	☐	☐	☐	☐	☐
How helpful are things like these self-test questions, where you write in the book and can then check your answers?	☐	☐	☐	☐	☐
How helpful are things like the drawing of the little coffee cup, that tell you when to take a break from study?	☐	☐	☐	☐	☐

Turn to Page 8

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these little pictures of the different characters?	☐	☐	☐	☐	☐
How helpful are the short notes about the characters in the margins of the page here?	☐	☐	☐	☐	☐
How helpful are paragraphs about each character, like those on this page?	☐	☐	☐	☐	☐

Turn to Page 9

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are things like the 'did you know' section in the margin?	☐	☐	☐	☐	☐
How helpful are things that tell you about the use of langauage in the book, like the sections on this page?	☐	☐	☐	☐	☐

Turn to Page 10

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Here are more 'examiner's secret' sections in the margin. How helpful are these?	☐	☐	☐	☐	☐
How helpful are questions like the ones here, that set you tasks to do or ask you questions about the book?	☐	☐	☐	☐	☐
How helpful is the page about literary terms here?	☐	☐	☐	☐	☐

Turn to Page 11

This is a page from a Revision Guide or Study Guide. It tells the story of the book in words and pictures.

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are the pictures?	☐	☐	☐	☐	☐
How helpful are the words?	☐	☐	☐	☐	☐
How helpful is the whole page, in helping you learn about the story?	☐	☐	☐	☐	☐

Turn to Page 12

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are the short summaries (the words in *italics*) that tell you what the next part of the play is about?	☐	☐	☐	☐	☐
How helpful are the paragraphs with headings (in **bold** text) that tell you what happens in detail?	☐	☐	☐	☐	☐
How helpful are the pictures of themes and characters for finding things?	☐	☐	☐	☐	☐
How helpful are things like the box, which summarises what happens in scenes one and two?	☐	☐	☐	☐	☐

Turn to Page 13

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are the pictures?	☐	☐	☐	☐	☐
How helpful are these short paragraphs about what happens in the book?	☐	☐	☐	☐	☐
How helpful is it that they are short paragraphs?	☐	☐	☐	☐	☐

Turn to Page 14

This is a page from a Revision Guide or Study Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are boxes, like this one here, that summarise what has happened to the main characters so far?	☐	☐	☐	☐	☐
How helpful are self-test questions like these?	☐	☐	☐	☐	☐

Turn to Page 15

This is a page from a Study Guide or a Revision Guide

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are lists of key quotations like the ones on this page?	☐	☐	☐	☐	☐
How helpful is it to have little pictures of the characters to help you find things in the book?	☐	☐	☐	☐	☐
How helpful is it to have the answers to self-test questions, like those shown here?	☐	☐	☐	☐	☐

Turn to Page 16

This is a page from a Study Guide or a Revision Guide.
How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
The coloured illustrations	☐	☐	☐	☐	☐
The short sentences about 'Setting'	☐	☐	☐	☐	☐
The notes about 'The Bare Facts of The Story'	☐	☐	☐	☐	☐
The colourful layout of pages like these	☐	☐	☐	☐	☐

Turn to Page 17

This is a page from a Study Guide or a Revision Guide.
How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
'Fill in the blanks' type of questions	☐	☐	☐	☐	☐
Pages like these, with questions for you to write the answers in	☐	☐	☐	☐	☐

Turn to Page 18

This is a page from a Study Guide or a Revision Guide. How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Pages that are just about single characters in a play or book, like this page	☐	☐	☐	☐	☐
Lists of key facts, like those in 'The bare facts' here	☐	☐	☐	☐	☐
Pictures to brighten up the page, like the one here of the ship	☐	☐	☐	☐	☐
Brief summaries of a character, like in the section 'He represents' here	☐	☐	☐	☐	☐
Things for you to think about, like in 'A question to consider' on this page	☐	☐	☐	☐	☐
Quotations, like those in the speech bubbles near the bottom of this page	☐	☐	☐	☐	☐
Short summaries, like the ones about Antonio's sadness, at the bottom of this page	☐	☐	☐	☐	☐

Turn to Page 19

This is a page from a Study Guide or a Revision Guide. How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Things like these, that tell you about one character's attitude to another	☐	☐	☐	☐	☐
Questions where the answers are not given, like in the top half of this page	☐	☐	☐	☐	☐
Facts about characters, with the place in the book where you can check that these are true, like in the 'Shylock on Antonio' part of this page	☐	☐	☐	☐	☐
Useful quotations to remember, like at the bottom of this page	☐	☐	☐	☐	☐

Turn to Page 20

This is a page from a Study Guide or a Revision Guide. How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Pages like this, that tell you about how to answer certain sorts of questions	☐	☐	☐	☐	☐
Questions for you to think about (like those in the yellow ovals) with explanations of what they mean	☐	☐	☐	☐	☐
Jokey bits, like at the bottom of this page	☐	☐	☐	☐	☐
How useful are pages like this, that have lots of different coloured shapes, arrows and boxes on them?	☐	☐	☐	☐	☐

Turn to Page 21

This is a page from a Study Guide or a Revision Guide. How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Pages like this one, that explain what questions are about	☐	☐	☐	☐	☐
The coloured boxes that explain questions, like the green ones about the 'Writer's message' and 'Characters'	☐	☐	☐	☐	☐
Things (the bottom half of this page) that talk about choosing the best question.	☐	☐	☐	☐	☐
Look at the language on this page. It uses lots of slang, like 'it's easy to make a duff choice', or 'this isn't such a big deal'. How helpful are books that are written like this?	☐	☐	☐	☐	☐

Turn to Page 22

This is a page from a Study Guide or a Revision Guide. How helpful are :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Short explanations about the different types of play or book ('Serious / Funny'), like at the top of this page	☐	☐	☐	☐	☐
Explanations like the one here for the meaning of 'dialogue'	☐	☐	☐	☐	☐
Explanations of the meaning of words like the one for 'soliloquy' in the middle of this page	☐	☐	☐	☐	☐
Information about things to write about, like the one at the bottom of this page about 'stage directions'	☐	☐	☐	☐	☐
Jokes, like at the very bottom of this page	☐	☐	☐	☐	☐

Turn to Page 23

This is a page from a Study Guide or a Revision Guide. How helpful is :

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
Information about the time in history when the book or play was written, like at the top of this page	☐	☐	☐	☐	☐
Information about different kinds of writing - like the bottom three quarters of this page about 'poetic verse', 'blank verse' and 'prose'	☐	☐	☐	☐	☐
This page uses informal, 'chatty' language quite a lot. How helpful to you is this way of writing?	☐	☐	☐	☐	☐

All these questions are about the computer software you have been using.

We want to know how much help these computer programs have been in helping you in your learning. You will need to look at the Sample Book to answer these questions.

Each set of questions is about one of the pages in the Sample Book.

Please turn to the page in the Sample Book and look at it carefully before answering the question for that page.

Remember: There are no wrong answers.

Turn to Page 24

These are some of the **'menu' screens** from the computer programs. Compare the computer programs with the kinds of things we have looked at so far in the Sample Book and tell me:

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How much more helpful are picture menus like these?	☐	☐	☐	☐	☐
How much more helpful is the computer for getting to know the book or play?	☐	☐	☐	☐	☐
How much more helpful is the computer for understanding things about the book or play?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning the story?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning about characters?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning about themes and images?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning about the time in history when the book or play was written?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning about the author?	☐	☐	☐	☐	☐
How much more helpful is the computer for learning about why the book or play is important to study?	☐	☐	☐	☐	☐

Turn to Page 25

These screens about **the story and different characters** are from the computer program

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful is the computer for learning about the story?	☐	☐	☐	☐	☐
How helpful is the computer for learning about individual characters?	☐	☐	☐	☐	☐
How helpful is the computer for learning about what happens to different characters?	☐	☐	☐	☐	☐
How helpful is the computer for learning about why some characters are more important than others?	☐	☐	☐	☐	☐

Turn to Page 26

These are some of the **maps** used by the computer

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these for learning where things in the story happen?	☐	☐	☐	☐	☐
How helpful are these for understanding important events in the story?	☐	☐	☐	☐	☐
How helpful are these for increasing your enjoyment of the book?	☐	☐	☐	☐	☐

Turn to Page 27

These are some of the **different types of questions** used by the computer

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these for keeping you interested in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your understanding of things in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your enjoyment of the book?	☐	☐	☐	☐	☐
How helpful is the feedback you get from these types of questions? ('feedback' is what the computer tells you when you pick an answer)	☐	☐	☐	☐	☐
How much more helpful are the computer questions than things in Study Guides or Revision Guides?	☐	☐	☐	☐	☐

Turn to Page 28

These are examples of **the way the computer tells you about** characters, background information, what happens in the book, etc.

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these for keeping you interested in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your understanding of things in the book?	☐	☐	☐	☐	☐
How much do they help you to remember important things about the book?	☐	☐	☐	☐	☐
How helpful are these kinds of screen for doing coursework or homework?	☐	☐	☐	☐	☐
How much more helpful is the computer than things in Study Guides or Revision Guides?	☐	☐	☐	☐	☐

Turn to Page 29

These are some of the **background information photographs** used by the computer

	very unhelpful	quite unhelpful	neither helpful or unhelpful	quite helpful	very helpful
How helpful are these for keeping you interested in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your understanding of things in the book?	☐	☐	☐	☐	☐
How helpful are these for increasing your enjoyment of the book?	☐	☐	☐	☐	☐
How helpful are they for learning more about why the author may have written the book?	☐	☐	☐	☐	☐
How much more helpful are these kinds of things than what is in Study Guides or Revision Guides?	☐	☐	☐	☐	☐
How far do these kinds of thing help to make the book come more 'alive' for you?	☐	☐	☐	☐	☐

Thank you very much for answering all these questions.

Your help is important for the research we are doing at Durham University.

Appendix 4

Sample Booklet of exemplar resources

School of Education

Sample Book

Research Project : ICT and English

The Merchant of Venice

by William Shakespeare (born 1564 - died 1616)

The Story In Brief

Setting - Where it Happens

- The action takes place about the 16th Century, in the City of Venice - Italy, and Belmont - meaning Beautiful Mountain.
- Portia's home is in Belmont, a short distance away from Venice.
- Antonio, Shylock and Bassanio carry on their business in Venice.

The Bare Facts of the Story

- Bassanio, a young Venetian gentleman, wants to marry Portia, who lives in Belmont. To do so, he needs money and asks his close friend, Antonio - the Merchant of Venice, to help him.
- Antonio's wealth is tied up in ships trading overseas. So Bassanio arranges to borrow from Shylock - a Jew, and Antonio guarantees the loan. The guarantee (bond) requires Antonio to forfeit one pound of his flesh to Shylock if it is not repaid within three months.
- Bassanio uses the money to pursue Portia, and wins her hand in marriage. Antonio fails to honour the bond in time and Shylock takes him to court.
- Portia, disguised as a lawyer, successfully defends Antonio. As a result, Shylock loses his wealth and must become a Christian.

Story Sub-Plots

The Flesh and Soul Bonds

Flesh

- Antonio agrees that Shylock may take a pound of his flesh, from whichever part of his body Shylock decides. (1.3.145)
- If a loan of 3000 ducats is not repaid. (1.3.100)
- Within three months. (1.3.100)

Soul

- Antonio agrees with Portia that his soul will be forfeit.
- If Bassanio ever intentionally breaks faith with her. (5.1)

Comparing the Bonds:

	Flesh	Soul
Agreed by	Antonio	Antonio
On Behalf of	Bassanio	Bassanio
With	Shylock	Portia
When	Start of Play	End of Play
Forfeit	Pound of Antonio's Flesh	Antonio's Soul
Condition	Repay 3,000 ducats	Never Break Faith
Period	3 months	Forever
Place	Venice	Belmont
Tone	Serious	Playful

Choosing a Casket

- Portia's father decreed in his will that she must marry the man who chooses correctly from three caskets.
- If a suitor chooses the wrong casket, he must forever remain unmarried.

Lead Casket

- Inscription says: "Who chooseth me, must give and hazard all he hath." (2.9.21)
- Inside is a portrait of Portia, and a scroll.
- Chosen by Bassanio.

Silver casket

- Inscription says: "Who chooseth me shall have as much as he deserves." (2.9.58)
- Inside is a portrait of a 'blinking idiot', and a scroll.
- Chosen by Prince of Arragon.

Gold Casket

Inscription says: "Who chooseth me, shall gain what many men desire." (2.9.24)

- Inside is a skull, and a scroll.
- Chosen by Prince of Morocco.

The Wedding Rings

- When Portia and Nerissa marry Bassanio and Gratiano, they give rings to their husbands, who vow never to part with them. (3.2.170-185)) Here, they are tokens of love.
- After the trial in Venice, Portia asks for her ring as a 'remembrance', persuaded by Antonio, Bassanio reluctantly agrees, as does Gratiano. (4.1.423 et seq) & (5.1.13) Here, they are marks of gratitude.
- Back at Belmont, Nerissa and Portia enjoy their husbands' discomfort as they ask about the rings. The disclosure of their identities at the trial makes everything clear. (5.1.257 et seq) Finally, the rings are symbols of forgiveness.

Jessica's Elopement

- Jessica is in love with Lorenzo, a Christian. (2.3.19)
- She plans to run away from home. (2.4.30)
- Steal as much as she can of her father's wealth. (2.4.31)
- Become a Christian. (2.3.21)
- Marry Lorenzo. (2.3.21)

Contrasts with Portia

- Jessica does not respect her father - Portia does.
- Jessica disobeys her father - Portia obeys hers..
- Jessica feely spends her father's wealth without his permission - Portia's wealth is conserved by her father's conditions about her marriage.
- Both act in a way that the audience will approve of: Jessica by disobeying her father, Portia by obeying hers.

Structural Elements

Symmetry in the Play

All the threes!

- 3 caskets
- 3 suitors
- 3 couples married
- 3 parent/child relationships
- 3 thousand ducats
- 3 month loan period
- 3 of Antonio's ships are saved (5.1.276)
- 3 times the amount of the Bond offered to Shylock. (4.1.231)

Contrasting parallels

- Flesh Bond in Venice - Soul Bond in Belmont
- Dutiful daughter, Portia - rebellious daughter, Jessica
- Unbounded hatred of Shylock for Antonio - unbounded love of Antonio for Bassanio.
- Shylock's hatred for Antonio has its basis in money - the latter's practice of lending without charging interest. Antonio's love for Bassanio is unaffected by his constant need for money.

Venice and Belmont

There is a contrast of themes, images and action between the centre of commercial activities - Venice, and Belmont - beautiful mountain.

Venice, the scene of:

- Shylock's hatred of Antonio. (91.3.39 et seq)
- Threat to Antonio's life in the Flesh Bond. (1.3.9) & (1.3.146)
- Elopement of Jessica from a hated
- News of Antonio's losses at sea - a for Shylock. (3.1.95)
- The trauma of the Trial scene. (4.1

Belmont, the scene of:

- A dutiful daughter doing her father's will. (1.2.103)
- Romantic tension asPortia waits to see who will win her hand in marriage. (1.2.130 et seq)
- Bassanio courting and winning Portia.(3.2.24 et seq)
- Nerissa agreeing to marry Gratiano. (3.2.209)
- News of Antonio's misfortune greeted with unstinting help and loving concern. (3.2.297)
- The final scene unites the various lovers and sees Antonio's fortunes repaired. (5.1.127 et seq)
- Sweet music and poetry.

Language and Poetry

- Shylock's language is usually simple, forceful, and direct. e.g. in discussing the Bond (1.3.156), in the loss of his daughter and money. (3.1.76)
- There is formal, dignified, and passionate oration in Portia's 'mercy speech (4.1.180) and in Shylock's defence of the Jewish people. (3.1.52)
- Note the literary and poetic descriptions of Antonio's merchant ventures. (1.1.9 et seq)
- Portia wants music played whilst Bassanio makes his choice of casket. (3.2.43)
- She praises music as a fitting accompaniment to a 'new crowned monarch'. (3.2.480)
- The song, prior to Bassanio choosing a casket, extolls the virtues of being ruled by fancy - love, rather than the head. (3.2.63)
- Jessica and Lorenzo recall classical legends of love. (5.1.1)
- Music greets the return of the triumphant couples and Antonio from Venice(5.1.88)

Background Elements

Religion and Usury

Anti-Semitism

- Shakespeare wrote a play that reflected the prevailing social and political attitudes to the Jewish people.
- However, he made Shylock more than a cardboard villain.
- He invested him with spirit and words that make all who hear them think carefully about their import.
- As a result, Shylock's role tends to overshadow Antonio's, particularly at this distance from the time in which it was written.
- Largely barred from pursuing traditional crafts, numbers of the Jewish people became money-lenders - a practice banned for Christians.
- After being bankrupted by the state, they were expelled from England in 1250.
- Readmitted to England in 1655.
- Few of Shakespeare's audiences would have ever met a Jew, most of their 'knowledge' being gained from heresay and legend - most of it false and exaggerated.

Usury

- This is the practice of lending money at an excessive rate of interest.
- Lending money at interest was forbidden by the early Christian church.
- Growth of trade in early Middle Ages saw its reluctant introduction.
- Permitted in England, subject to restrictions, 1546.
- Banned in 1552.
- Legalized in 1571.
- Still very much a matter of discussion and ill-feeling in Shakespeare's time.

A play is written to be performed on stage. Try your best to see a live production. At least watch a film or video version.

Other Characters

Jessica

General
- Daughter of Shylock
- In love with Lorenzo - a Christian

Attitude towards her father and home
- Unhappy at home - 'our house is hell'. (2.3.2)
- Not dutiful towards her father - in contrast to Portia. (2.3.7)
- Ashamed to be Shylock's daughter. (2.3.18)
- Will become a Christian - perhaps the ultimate betrayal of Shylock. (2.3.20)
- Deceives and betrays him when left in charge of the house. (2.5.15)

Character points
- Determined - will leave her father and become a Christian. (2.3.20)
- Plans well, organises her own escape and the theft of Shylock's money. (2.4.29)
- Ruthless - will take as much of Shylock's wealth as she can. (2.4.31)
- Modest - does not want to be seen in a boy's clothes. (2.6.39) and (2.6.49)
- Lorenzo says she is wise, beautiful, reliable/true. (2.6.53)
- Free spending - with her father's money, and in contrast to him. (3.1.111)
- Romantic and poetic. (5.1.6 et seq)
- Music makes her quiet and reflective. (5.1.69)

Gratiano

General
- Friend, and foil to Bassanio.
- Sensitive towards Antonio. (1.1.73)
- Joyous, extrovert. (1.1.79)
- Loves Antonio. (1.1.87)
- Lorenzo complains the Gratiano never lets him speak. (1.1.106)
- Hugely enjoys Shylock's downfall. (4.1.310)

Bassanio on Gratiano
- 'Speaks an infinite deal of nothing'. (1.1.115)
- 'Wild rude and bold of voice'. (2.2.173)
- Tells him to watch his behaviour in Belmont. (2.2.177 et seq)

Rebuked
- By Antonio for arriving late at the boat and delaying Bassanio. (2.6.62)
- By Shylock. (4.1126)
- By Portia for speaking 'grossly'. (5.1.266)

Nerissa

- Maidservant to Portia, but really much more of a companion and close friend.
- Compliments Portia's father. (1.2.27)
- Supportive of Portia - points out the good aspects of her father's will. (1.2.32)
- Wishes Bassanio is the new wooer. (2.9.100)
- Parallels Portia's and Bassanio's relationship:
  - i. Marries Gratiano. (3.2.209)
  - ii. Gives Gratiano a ring. (5.1.13)
  - iii. Demands the ring when in disguise. (5.1.13)

Lorenzo

- Follows Jessica's plans for the elopement. (2.4.30)
- Must be prepared to face criticism for marrying a girl from the Jewish race.
- A lover of music and poetry. (5.1.1 et seq)
- His musings on music and the heavens present an idea of universal harmony - soon to be fulfilled with the return of the lovers from Venice. (5.1.55)

The Gobbos

- The Gobbos add a touch of humour to the proceedings. (2.2.1 et seq)
- Lancelot's change of master is a small commentary on Shylock's household. (2.2.1)
- Shylock calls Lancelot lazy - and is probably correct. (2.5.46)
- Jessica calls him a 'merry devil'. (2.3.2)

Arragon

- The Prince of Arragon is a suitor for Portia's hand. (2.9.2)
- Arragon's name suggests arrogance and pride.
  - i. He rejects gold because it promises what many (fools) desire. (2.9.25) he feels himself superior to the 'common spirits'. (2.9.31)
  - ii. He rejects the lead casket, being unwilling to hazard all (for love) (2.9.21)
  - iii. He chooses silver because he believes he 'merits' Portia's hand. (2.9.37 et seq)
- He is a caricature Spaniard - Spain was a traditional enemy of England.

Morocco

- To an extent, in his appearance and the choices he makes, he embodies the theme of appearances verses reality.
- He rejects lead, not being prepared to hazard all for such a base metal. (2.7.17)
- He rejects silver as he 'deserves' more. (2.7.30)
- He equates the appearance of gold with inner worth. (2.7.36 et seq)

Useful Quotations

Antonio

In sooth, I know not why I am so sad. 1.1.1
My ventures are not in one bottom trusted,
Nor to one place 1.1.42
I hold the world . . .
A stage where every man must play a part,
And mine a sad one. 1.1.77
My purse, my person, my extremest means,
Lie all unlocked to your occasions. 1.1.138
The devil can cite Scripture for his purpose. 1.3.95
O, what a goodly outside falsehood hath! 1.3.99
I am as like to call thee so again,
To spit on thee again, 1.3.126
The Duke cannot deny the course of the law, 3.3.26
I am the tainted wether of the flock,
Meetest for death. 4.1.113
. . . I dare be bound again,
My soul upon the forfeit, that your lord
Will never more break faith advisedly. 5.1.251

Shylock

Three thousand ducats for three months and
Antonio bound. 1.3.9
I will buy with you, sell with you, talk 1.3.33
I hate him . . . more for . . .
He lends out money gratis and brings down
The rate of usance 1.3.39
You call me misbeliever, cut-throat, dog,
And spit upon my Jewish gaberdine, 1.3.108
. . . let the forfeit
Be nominated for an equal pound
Of your fair flesh to be cut off and taken
In what part of your body pleaseth me. 1.3.145
And the vile squealing of the wry-necked fife, 2.5.30
Justice! The law! My ducats and my daughter! 2.8.17
. . . I am a Jew. Hath not a Jew eyes?
Hath not a Jew hands, organs . . .
. . . If you prick us, do we not bleed? . . . 3.1.55
. . . I would my daughter were dea
foot, and the jewels in her ear! 3.1
. . . I will have the heart of him if h
. . . by our holy Sabbath have I swo
To have the due and forfeit of my h
I stand for judgement. Answer: shal
. . . I stand here for law. 4.1.141
An oath, an oath! I have an oath in heaven.
Shall I lay perjury upon my soul? 4.1.225
. . . you take my life
When you do take the means whereby I live. 4.1.372
I am not well. 4.1.391

Bassanio

Graziano speaks an infinite deal of nothing, 1.1.114
To you, Antonio,
I owe the most in money and love, 1.1.130
In Belmont is a lady richly left, 1.1.161
I like not fair terms and a villain's mind. 2.1.176
Thou art too wild, too rude and bold of voice 2.2.173
. . . when this ring
Parts from this finger, then parts life from hence. 3.2.183
I freely told you all the wealth I had 3.2.252
. . . the kindest man,
The best-conditioned and unwearied spirit 3.2.290
To do a great right, do a little wrong, 4.1.213
But life itself, my wife, and all the world
Are not with me esteemed above thy life. 4.1.281

Portia

. . . my little body is aweary
of this great world. 1.2.1
If to do were as easy as to know . . . 1.2.12
Double six thousand, and then treble that, 3.2.298
Then must the Jew be merciful. 4.1.179
. . . mercy . . . blesseth him that gives and him that takes.
. . . It is enthroned in the hearts of kings;
It is an attribute of God himself,
And earthly power doth then show likest God's
When mercy seasons justice. 4.1.184 - 194
'Twere good you do so much for charity. 4.1.258
. . . if thou dost shed
One drop of Christian blood, thy land and goods
Are by the laws of Venice confiscate 4.1.396
Soft! The Jew shall have all justice. . . .
He shall have nothing but the penalty. 4.1.317
He shall have merely justice and his bond. 4.1.335
Down, therefore, and beg mercy of the Duke. 4.1.359
What mercy can you render him, Antonio? 4.1.374

Duke

A stony adversary, an inhuman wretch
Uncapable of pity, void and empty
From any dram of mercy. 4.1.3
We all expect a gentle answer, Jew. 4.1.33
How shalt thou hope for mercy, rend'ring none? 4.1.87
That thou shalt see the difference of our spirit,
I pardon thee thy . . . 4.1.364

Jessica

Our house is hell, 2.3.2
Alack, what heinous sin it is in me
To be ashamed to be my father's child! 2.3.16
I have a father, you a daughter, lost. 2.5.56
That he would rather have Antonio's flesh
Than twenty times the value of the sum 3.2.284

Lorenzo

. . . She hath directed
How I shall take her from her father's house, 2.4.29

Solanio

I think he only loves the world for him. 2.8.50

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- Solanio refers to him as a 'dog' (2.7.14), 'villain Jew' (2.8.4), 'devil' (3.1.20), 'cur' (3.3.17).
- Lancelot complains of being ill-fed in his service. (2.2.101)
- The Duke has a very low opinion of him. (4.1.2)
- Gratiano calls him numerous names and 'baits him during the Trial, e.g.,
  i. 'inexecrable dog' (4.1.127)
  ii. he says that Shylock's desires are 'wolvish, bloody, starv'd, and ravenous' (4.1.137)

Points to note

- Single-minded. He goes to supper with Bassanio 'for hate'. (2.4.13)
- Dislikes merrymaking and music. (2.5.30)
- Seems to have some regard for the memory of his dead wife. (3.1.115)

Portia

General

- A wealthy heiress. (1.1.161)
- Lives in Belmont. (1.1.161)

Bassanio on Portia

- She is rich, fair, virtuous. (1.1.161)
- He believes she favours him. (1.1.164)

Portia on Bassanio

- Remembers him as worthy of Nerissa's praise. (1.2.117)
- She wants him to stay a while, before making his choice. (3.2.1)
- She openly suggests he has taken her heart. (3.2.10 et seq)
- Note the rhyming with the word 'lead' in 3.2.63-70. Is she trying to tell him something? Do the words also warn him not to be taken in by appearances?
- She wants to share in his troubles. (3.2.246)

Portia and the Trial

- She immediately recognises the strength of Shylock's case and suggests he must show mercy. (4.1.179)
- Her speech on 'mercy' sets a standard against which Shylock - especially, and Antonio and the Duke will be measured. (4.1.181)
- She swiftly moves the trial to its crux - Shylock preparing to take his bond. (4.1.252)
- Gives Shylock a chance to show charity, if he will not be merciful. (4.1.258)
- She shows a sharp intelligence when she introduces a legal quibble over what constitutes flesh. (4.1.303)
- As Shylock rejected mercy, so Portia offers him only unfeeling justice, (4.1.312) - exactly what he had demanded himself.
- At the end she drives her point home to Shylock, by pointing out that his only hope is the mercy that he would not give to Antonio. Mercy from the Duke (4.1.351), and from Antonio (4.1.374).

Points to note

- Like Antonio, she says she is 'weary'. (1.2.1)
- Unable to choose her own husband. (1.2.22)
- Witty and scathing about her suitors so far. (1.2.39)
- In all her speeches prior to the trial she demonstrates a ready wit and command of words and language. This will be a great strength at the trial.
- Obedient to her dead father's wishes. (1.2.103)
- Perhaps not too enamoured with the Moor's appearance. (1.2.127) & (2.7.77)
- Prepared to accept him, despite appearance, and to judge him as 'fair' as any other suitor. (2.1.20)
- Her comment to Arragon 'To offend and judge are distinct offices' (2.9.60), echoes events to come.
- Instantly shows loyalty to Bassanio's friend. (3.2.298-310)
- Swiftly, efficiently and effectively organises her affairs after Bassanio leaves to be with Antonio. (3.4.10-84)
- Her manipulating of her husband over the ring she gave him shows a sense of wit and humour.

Major Themes

Justice and Mercy

It is in the Trial - Act 4 Scene 1, that the concept of justice plus mercy is presented in contrast to unyielding justice - the application of just the letter of the law.

The Duke represents the law of Venice.

- He is bound by its letter and is powerless in the face of its requirements. (4.1.215)
- He has to be prepared, albeit reluctantly, to see Antonio die.
- He taxes Shylock with the question of how Shylock could hope for mercy, if he gives none. (4.1.87)
- At the end he shows mercy when he could have demanded the letter of the law, and Shylock's death. (4.1.365)

Shylock's justice:

- He is not interested in justice, only how the law can let him kill Antonio.
- He has taken an oath to kill Antonio if he gets the opportunity. (3.1.119) & (4.1.225)
- The Duke recognises Shylock is without mercy. (4.1.5)
- Shylock points to a threat to Venice's law and reputation if his claim is not legally allowed. (4.1.37)
- He refuses to justify his actions. (4.1.42) and insists on his bond. (4.1.86)
- Shylock stands 'here for law'. (4.1.141)
- In response to Portia's plea for mercy he demands only the letter of the law. (4.1.203)

Portia's justice:

- Almost her first words point out that Antonio's life depends on mercy from Shylock. (4.1.179)
- Mercy blesses the giver and the taker. (4.1.184)
- It is an attribute of kings and God. (4.1.191-2)
- Justice alone would see all of us damned in God's eyes. (4.1.194)
- Justice must be 'softened' by mercy. (4.1.200)
- She will not however, allow the law to be set aside. (4.1.215 et seq)
- She asks Shylock to exercise some charity towards Antonio. (4.1.258)

Her justice is merciless in the face of Shylock's stubborn insistence on just the law.

- His lands and goods will be lost if he spills a drop of Christian blood. (4.1.307)
- He will not have his money - only the flesh, which he dares not take. (4.1.318)
- Because he sought Antonio's life all his wealth is confiscated. (4.1.345 et seq)
- His only, and final option, is to beg for mercy. (4.1.359)

She expects those who are awarded justice to show mercy, just as she expected it of Shylock.

- She looks to the Duke to show mercy. (4.1.351 et seq) as it is seen as the 'attribute of kings' (4.1.191), and by implication Dukes and other rulers.
- She also turns to Antonio and asks what mercy he can show. (4.1.374)

Love/Friendship and Money

In Act 1 we learn that 'In Belmont is a lady richly left' (1.1.161) The pursuit of this lady, Portia, is what drives the action on. Money/wealth is a dominant image in the opening scenes.

- Portia's wealth engages Bassanio's attention. (1.1.161)
- Bassanio needs money to pursue Portia. (1.1.173)
- Antonio is a wealthy merchant wh
- loaned money to Bassanio. (1.1.13
- Shylock is turned to as a source of

During the course of the play mone have a negative impact.

- Shylock's hatred is driven by Antonio's attitude towards usury. (1.3.41) & (3.1.52)
- He is more concerned about the loss of his money and jewels than the loss of his daughter. (2.8.15)
- Morocco (2.9.24) and Arragon (2.9.58) are deceived by the appearances of wealth - gold and silver caskets.
- Antonio pledges his flesh to guarantee the money his friend needs. (1.3.168)

Love and friendship provide the contrast:

- Antonio freely gives of his wealth to Bassanio - for love and friendship. (1.1.138 et seq) & (2.8.50)
- Bassanio's love for Portia drives him to be honest with her about his lack of money. (3.2.254)
- Bassanio freely grants Gratiano's wishes, for friendship's sake. (2.2.170)
- Portia immediately, and willingly, is prepared to give freely of her money in order to assist Antonio, out of love for her husband. (3.2.298)

By Act 5 the dominant image is love and fulfilment.

- Shylock and his hatred have effectively been 'dismissed' from everyone's thoughts.
- Jessica and Lorenzo open the scene with images of love and peace. (5.1.1 et seq)
- The 'sounds of music', and 'sweet harmony', prepare for the entrance of the main players. (5.1.55 - 57)
- Portia, Bassanio, Nerissa and Gratiano are re-united in love.(5.1.130 et seq)
- Antonio pledges his soul to guarantee his friend's love. (5.1 251)

Appearance and Reality

Solanio's reference to 'two-headed Janus' (1.1.50), the Roman god that had two faces, smiling and frowning, could be symbolic of this theme that covers a range of events and ideas.

Disguise

- Jessica dresses as a boy when she escapes from her father's house. (2.6.39)
- Portia and Nerissa disguise themselves as men when they travel to Venice to defend Antonio. (3.4.63)

Perceptions of value

- The Moor – Prince of Morocco, chooses gold. (2.7.13 et seq) 'All that glisters is not gold' (2.7.65) 'Gilded tombs do worms infold.' (2.7.69)
- Prince of Arragon chooses silver. (2.9.18 et seq) Assumes he 'deserves' Portia. He doesn't, and his arrogance is his downfall.
- Bassanio chooses lead. (3.2.73 et seq) 'The world is still deceived with ornament.' (3.2.74) 'seeming truth' (3.2.100) 'You that choose not by the view.' (3.2.131)

Hidden evil

- False words – the 'devil can cite Scripture'. (1.3.95)
- 'A goodly apple rotten at the heart.' (1.3.98)
- 'What a goodly outside falsehood hath!' (1.3.99)
- 'Fair terms and a villain's mind'. (1.3.176)
- 'A creature that did bear the shape of man.' – Shylock. (3.2.273)

Other

- Portia says the Moor's colour will not affect her judgement. (2.1.20)
- Bassanio disguises his intention to ask Antonio for another loan, (1.1.154) and action that brings a sharp rebuke.
- People may appear wise by saying nothing, but when they open their mouths their lack of wisdom becomes obvious immediately. (1.1.95 et seq)

Major Characters

Antonio

General
- He is The Merchant of Venice of the play's title.
- Wealthy (1.1.41)
- A mature person, though he is not seen in the company of similar men. Is this because of his love for the younger Bassanio, whose company he keeps and whose friends are therefore also his?
- He represents the Renaissance ideal of the perfect Christian gentleman. (His treatment of and attitude towards Shylock would not have seemed out of place to his audience.)

Lonely Figure
- In Venice, as the play begins, he is a lonely figure, sad and melancholic. (1.1.1) His melancholy could also be an omen of impending threats.
- He doesn't understand his own sadness. (1.1.7) Believes he has a sad part to play in life. (1.1.77) He is patient in the face of adversity, (4.1.10) and resigned to his fate. (4.1.114)
- In Belmont, at the end, Portia has 'given' him his life, and brought news that his living (ships) are safe. But he is still noticeably alone. (5.1.286)

Love for Bassanio
- He sadness likely comes from his love of Bassanio, and the fact that he is probably going to lose him to Portia - see point c, below.
- His sadness is recent. (1.1.75)
- His first words to Bassanio are about Portia. (1.1.119)
- His generosity towards Bassanio to help him raise money knows no bounds. (1.1.138 & 153 & 177)
- He is even willing to go against his own custom of never paying interest. (1.3.60)
- For Bassanio he enters into a bond with Shylock that has his flesh as a forfeit. (1.3.168)
- 'I think he only loves the world for him.' (2.8.50)
- When his ships appear to have been lost, his letter to Bassanio pleads only that he might see him before Antonio dies. (3.2.313) He repeats this plea. (3.3.36)
- No regrets, accusations or recriminations – he will willingly die for his friend. (4.1.276)
- Offers his soul to Portia as a bond for Bassanio to guarantee that Bassanio will never willingly deceive her. (5.1.252)

Thoughtful
- Warns Bassanio to beware of false witness and judging by appearances. (1.3.95-99)

Prophetically Ironic
- Suggests Shylock might become a Christian. (1.3.175)

Confident in Business
- All his fortune not tied up in current ventures. (1.1.40)
- Believes his merchant ventures will be a success – which they are, but not in time to save him from forfeiting the bond. (1.3.178)

Attitude towards Shylock
- We never seen him spit on or kick Shylock, though he obviously has (1.3.103), and says he will do it again. (1.3.126) If we saw this on stage, would it change our attitude towards him?
- His attitude towards the Jews and their nation would not be seen as strange in Elizabethan England.
- He shows 'mercy' when he does not immediately take all of Shylock's money, and even more mercy, in Elizabethan eyes, when he requires him to become a Christian! (4.1.377)

Bassanio on Antonio
- Says he is 'marvellously changed' - sadness. (1.1.76)
- Owes most to Antonio 'in money and in love' (1.1.138)
- 'Dearest friend . . . kindest man' always courteous and acts only from the highest motives. (3.2.290)

Shylock on Antonio
- Hates him because he is a Christian, and complains about Shylock's business practices. (1.3.38)
- Suggests he looks like a 'fawning publican' - a servile (humble) tax collector. (1.3.38)
- Mainly hates him because he lends money without interest. (1.3.41)
- Depth of hatred is seen when Jessica reports he 'would rather have Antionio's flesh' than 20 times the bond amount. (3.2.284)

Others on Antonio
- Respected and loved by Gratiano. (1.1.87)
- Solario and Solanio concerned for Antonio's wellbeing. (2.8.32-34)
- Solanio suggests Antonio only loves the world for Bassanio. (2.8.50)
- Solanio refers to him as 'good' and 'honest'. (3.1.13)
- Gaoler has asked Shylock to show mercy. (3.3.10)
- The Duke pleads on his behalf. (4.1.19)

Bassanio

General
- Young man of Venice.
- Already in debt to Antonio. (1.1.130)
- Needs to repair his fortune. (1.1.134)
- He is, perhaps, an 'emergent' Antonio.

Attitude towards Portia
- Recognises that marriage to her would repair his fortune. (1.1.161)
- Sees more than just her money - she is beautiful and has 'wondrous virtues'. (1.1.162)
- He believes she favours him. (1.1.163)
- Is honest in his dealings with her, telling her when they first meet, that he has no money. (3.2.254)
- Loves her - only Antonio could have persuaded him to give away her ring. (4.1.445)

Relationship with Antonio
- Close friendship which has already allowed him to borrow money from Antonio. (1.1.130)
- Shows some embarrassment when driven to ask him for yet another loan - he does not come straight to the point. (1.1.140)
- His reaction to news of Antonio's peril demonstrates genuine love and affection for him. (3.2.241)
- Unstinting in his praise of Antonio. (3.2.290)
- Willing to sacrifice everything for him. (4.1.111)

Positive Characteristics
- Practical
  - i. Acknowledges that marriage to Portia will repair his fortunes. (1.1.161)
  - ii. Recognises that Gratiano's manner might jeopardize his pursuit of Portia. (2.2.180)
  - iii. Confronts Gratiano about his behaviour to pre-empt any possible problems.(2.2.172)
- Honest
  - i. Confesses his own shortcomings to Antonio. (1.1.122)
  - ii. Despite his own desires, warns Antonio against entering the bond with Shylock. (1.3.150)
  - iii. Blunt in telling Gratiano to his face what his faults are. (2.2.172)
  - iv. Tells Portia he has no fortune. (3.2.254)
- Generous - instantly grants Gratiano's request, even before knowing what it is. (2.2.170)
- Intelligent - not taken in by the appearances presented by the caskets. (3.2.74)
- Has numerous friends. (1.1)
- Complimented by Nerissa, (1.2.114) and Portia. (1.2.117)
- Lighthearted and fun-loving (1.1.166)
- Perceptive - in his assessment of Gratiano. (1.1.114)

A Negative View
- Feckless - has lost his own fortune. (1.1.130)
- Reckless - leads his friend into a dangerous bond so he can pursue an uncertain love. (1.3.60)
- Uses other people's money
  - i. Pursues Portia on Antonio's money. (1.1.173)
  - ii. Offers to pay back the bor (4.1.83)
- Mercenary - Pursues Portia s (1.1.161)

Shylc

General
- Probably elderly.
- A money-lender by trade. (1.3.1)
- He is a Jew - an important fact for the Elizabethan audience. (1.3.109)

He hates Antonio because he:
- Takes business away by lending money free of interest - this is the main reason for Shylock's hatred. (1.3.41) & (3.1.52)
- Laughs at and mock him. (3.1.52)
- Scorns Shylock's nation. (1.3.45) & (3.1.53)
- Antonio is a Christian. (1.3.39)

A wronged man
- Antonio's action in spitting on his beard and kicking him strike the wrong note with a modern audience. (1.3.109 et seq)
- His daughter's desertion and her theft of his money may engage our sympathy to an extent. (2.6.49)
- We can sympathise with his plea that he is as much a man as any Christian. (3.1.56)
- He is legally justified in bringing Antonio to court and demanding his forfeit. (4.1.228) Legal quibbles deprive him of his revenge. (4.1.307)

He loses sympathy
- Lancelot complains of being ill-fed in his service. (2.2.101)
- Jessica, his daughter, says their house is hell. (2.3.2)
- She is ashamed to be his daughter. (2.3.17)
- Only in interested in profit - Lancelot is 'snail slow' in profit. (2.5.56)
- More concerned about loss of his money than loss of his daughter. (2.8.15)
- No remorse or wonder that his daughter should have left him, only self-pity. (3.1.90)
- He takes an oath to kill Antonio. (3.1.119) & (4.1.225)
- He rejects pleas to be merciful from the Goaler. (3.3.10) and from the Duke. (4.1.19)
- His action of sharpening his knife in court is cruel. (4.1.120)
- He rejects many times the amount of the bond, wanting only Antonio's flesh. (4.1.224)
- He rejects Portia's plea to be merciful when she grants his case. (4.1.230)
- He rejects her plea to be charitable and have a surgeon ready to bind Antonio's wounds. (4.1.254)
- He shows himself well capable, and desirous, of cutting Antonio's flesh himself. (4.1.301)

His punishment
- The law allows that half his money goes to the State, and half to Antonio, and the Duke may have him executed. (4.1.347)
- Despite Shylock's refusal to be merciful or charitable in victory, the Duke and Antonio are.
  - i. The Duke lets him live. (4.1.365)
  - ii. Antonio asks the Duke to remit the State's fine - which he does. But when Shylock dies all he owns must go to his son-in-law. (4.1.377)
  - iii. Antonio requires that Shylock must become a Christian - this would have met with approval in Elizabethan eyes. (4.1.383)

Others on Shylock
- Antonio makes reference to the devil, 'evil soul', villain, and 'apple rotten' when referring to Shylock. (1.3.95)
- Bassanio speaks of his 'villain's mind' (2.1.176), says he is unfeeling and cruel. (4.1.62)
- Lancelot says the 'Jew is the very devil incarnate.' (2.2.25)
- Jessica, his daughter, says their house is hell. (2.3.2)
- She is ashamed to be his daughter. (2.3.17)

Act, scene and line references are written in the form - 3.1.88, i.e., Act 3, scene 1, line 88. Your text may vary slightly, but should be close.

Map of Maycomb

Map of Alabama

came to their rescue and she realises this man is Boo.

A feeling of suspense is created through the use of language in

Chapter 28. The reference to the 'solitary mocker' (Ch. 28, p. 281) at the beginning of the chapter foreshadows the mockingbird (Boo) appearing later.

The incident with Cecil jumping out on Jem and Scout is timely, as the reader expects danger but it turns out to be a prank. The author is cleverly building up the parallels, for instance one of the pageant stalls consisted of the unseeing children being made to touch imaginary parts of a human (see **Structure**). Thus when the Robert Ewell episode occurs later, the climax is even more dramatic and sinister in contrast.

Note that Aunt Alexandra dresses Scout in her tomboy clothes in which she will be comfortable following the disturbing incident with Robert Ewell. At important times like these Aunt Alexandra forgets her strife to make Scout into a lady.

CHECKPOINT 25
What does such an act make us feel towards Aunt Alexandra?

CHAPTERS 30–1 – A private trial

1. **Doctor Reynolds arrives and asks everyone to leave the room while he examines Jem.**
2. **Atticus, Heck Tate, Arthur (Boo) Radley and Scout go out onto the porch. Scout leads Boo into a seat in a shadow as she senses that he will be more comfortable there.**
3. **Atticus discusses the incident with Heck Tate. Atticus does not understand why Heck is insisting that Bob Ewell fell on his knife and believes that the incident must come to court, even though it would be difficult for Jem.**
4. **He eventually understands that Heck is trying to protect Boo Radley's privacy.**
5. **Scout takes Boo Radley in to see Jem who is asleep, and then, at Boo's request, walks him home, the last she will see of him.**
6. **As Scout walks home she looks back at the incidents that have happened from Boo's viewpoint and contemplates Atticus's moral of seeing things as if standing in another's shoes.**
7. **Scout joins Atticus beside the sleeping Jem and very soon after Atticus begins to read her *'The Grey Ghost'* (Ch. 31, p. 309) she has fallen asleep.**

Although we suspect it was Boo, we are not certain whether it was Jem or Boo who stabbed Bob Ewell with his knife. Harper Lee implies that this is not the real issue here, but instead the importance of protecting an innocent creature (Boo) from society. Atticus is persuaded by Heck that the public's legal system is not suitable here, that they must judge the system by their own rules and sense of justice. The legal system was not sufficient to save the other mockingbird of the story. We do not know whether Scout has completely understood Atticus and Heck's conversation, or whether she has just responded to Heck Tate's repetition of the word 'sin' and linked it with Atticus's lesson in Chapter 10 when the mockingbird is first introduced. But her words are poignant when she says that if the incident was exposed to the public 'it'd be sort of like shootin' a mockingbird' (Ch. 30, p. 304).

Heck Tate employs as evidence Bob Ewell's left-handedness (Ch.30, p. 302)

CHECKPOINT 26
Note the recurring mockingbird **motif**. Why could Jem also be linked to the mockingbird theme here?

GLOSSARY
The Grey Ghost a book referred to right at the start of the novel; this could be used to achieve a sense of a completed circ remind us how children felt ab ghost of Boo a beginning

Page 6

Chapters 30–1 continued

EXAMINER'S SECRET

The repetition of themes often gives an indicator of a message the writer is trying to portray. The end of the text is also a good place to look for a summary of the writer's point of view.

in the same way that Atticus has done in the previous trial of Tom Robinson (see **Theme** on **Structure**).

As Scout is looking back on events, summarising the story in a dream-like fashion, she refers to herself and Jem as 'his children' and 'Boo's children' (Ch. 31, pp. 307–8). This has religious overtones of 'God's children' and therefore implies that Boo has been watching over Scout and Jem through the episodes of the novel.

Everything has now been concluded: Scout has seen Boo, Robert Ewell is dead and justice has been achieved. Likewise the **genre** of **bildungsroman** (see **Theme** on **Growing up**) has been satisfied, as Scout considers 'there wasn't much left for us to learn' (Ch. 31, p. 308), now truly understanding Atticus's maxim and therefore holding no fear. However, Scout still has a few years to go until she is able to look back as a more mature narrator.

CHECKPOINT 27

Has the reader been prepared by earlier incidents for Boo to save the children?

Now take a break!

WHO SAYS ...?

1 'I think I'm beginning to understand why Boo Radley's stayed shut up in the house all this time ... it's because he wants to stay inside'

2 'There's a black boy dead for no reason, and the man responsible for it's dead ... Let the dead bury the dead'

3 'Hypocrites, Mrs Perkins, born hypocrites'

4 'Over here we don't believe in persecuting anybody. Persecution comes from people who are prejudiced'

5 'This is their home, sister ... We've made it this way for them, they might as well learn to cope with it'

ABOUT WHOM?

6 '... they must never do this again. Times are too hard ...'

7 'You couldn't but *they* could and did.'

8 'A strange small spasm shook him, as if he heard fingernails scrape slate, but as I gazed at him in wonder the tension slowly drained from his face.'

Check your answers on p. 81.

reminds Cal to tell them that they mustn't do this again as life is hard. Cal is the person that Atticus chooses to accompany him to tell Helen Robinson of her husband's death.

Dill (Charles Baker Harris)

From Mississippi
Age: nearly seven to nearly ten
Curious
Vivid imagination
Sensitive
Unstable family

Dill comes from Mississippi every summer to stay with his Aunt Rachel and to play with Jem and Scout. He features largely in the first eleven chapters of the novel where he is fascinated with Boo Radley and goads Jem and Scout into trying to see this mystery figure. Through these incidents we learn of his curious and quick-thinking nature.

In the second part of the novel Dill is only present as a contrast to Jem and Scout – we do not see this character mature as we do with the others. At the trial Dill's sensitive nature is contrasted with the logical and rational Scout. Whereas Jem wants to confront prejudice, Dill decides to accept things the way they are and make the best of them – consequently his choice of profession will be a laughing clown! Dill provides for Scout a practical example in family dynamics. He feels unwanted by his fractured family but she knows only love from her single parent. Dill dwells in his 'own twilight world' (Ch. 14, p. 158); perhaps his wild imagination is stimulated by an unhappiness in his everyday existence.

Aunt Alexandra

Sister of Atticus and Jack
Family-oriented
Proud
Racist
Traditional, rigid
Sympathetic?

Alexandra Finch is Jem and Scout's aunt. She lives at Finch's Landing which is associated with a past of cotton-growing and slave-owning. Unlike her brothers, she has not moved away and made a new life for herself and perhaps consequently, as Scout discovers, she holds onto traditional views and is obsessed with family heredity.

She first features in the story when Atticus, Jem and Scout go to spend Christmas at Finch's Landing. She disapproves of Scout's tomboy ways. She becomes a major character in the plot when she invites herself to stay at the Finch home in Maycomb, to help Atticus with the children during the difficult trial period. The Finch family seemed to get on better with Calpurnia and without Aunt Alexandra! Aunt Alexandra and Atticus have fundamentally different attitudes to child rearing and servant supervision.

Although Aunt Alexandra is not favourably portrayed by Scout, she has several redeeming moments – most notably when she detaches herself from the hypocritical Missionary Society meeting and expresses emotional sympathy for Atticus at the news of Tom's death. She picks up her dignity and returns to her guests, and Scout, all at once, appreciates this lady's behaviour.

Miss Maudie Atkinson

Down-to-earth
Sharp-witted
Supporter of Atticus
Mother figure

As Scout and Jem's neighbour, who is always out working in her garden, Miss Maudie is a source of information and company for the children. As with Calpurnia, the reader feels positive towards this character as a result of Scout and Atticus liking and valuing her. She does not talk down to them but gives them respect, although they do not always understand her. She talks to Scout about the problems of rigid religion, of what Arthur Radley was like as a child, of Atticus's talents. She disapproves of neighbourhood gossip and prejudice. She dislikes how the town comes out to watch 'a poor devil on trial for his life' (Ch. 16, p. 176), and silences Mrs Merriweather over her hypocrisy at Aunt Alexandra's tea-party.

Her major role in the plot therefore seems to be to reinforce Atticus's philosophy, and to be a constant, reassuring and sensible model for the children when Atticus is busy elsewhere.

Mrs Henry Lafayette Dubose

Another Finch neighbour
Old and ill
Typical Maycomb values
Cantankerous, racist
Lonely?
Courageous?

Mrs Dubose is known in the neighbourhood as the 'meanest old woman who ever lived' (Ch. 4, p. 39). In contrast to Miss Maudie who represents the friendly side of the community, Mrs Dubose represents the traditional and prejudiced side. Jem and Scout try to avoid her as Atticus has told them that they must maintain politeness even though her language is 'vicious' (Ch. 11, p. 110).

It is Mrs Dubose's shouting of racist comments to the children about Atticus, that makes Jem finally lose his temper and behead her camellias. She chooses to punish him by making him read to her every night for a month. This punishment is indicative of somebody who is desperately lonely and seems to need distracting. When she dies the children learn that she was struggling to combat a morphine

polite way of saying that the person does nothing. Varieties of speech are often used to make a social comment about a character:

- Child dialogue and use of slang are notable. See Jem, Scout and Dill's conversation at the end of Chapter 1. The narrator is clearly skilled in capturing children's language, but she is not restricted to this as she tells her story from a mature perspective.
- Robert Ewell uses a crude, harsh language at the trial and refers to Mayella being raped, 'screamin' like a stuck hog' (Ch. 17, p. 190). This is a grotesque metaphorical comment and it shows what little love and respect he has for his daughter. His swear words in the trial work in turning us against this character.
- Mayella's dialect is equally broad, representing the uneducated white community. She takes offence to Atticus's address of 'Ma'am' and 'Miss Mayella' (Ch. 18, p. 200), showing us that she has not been exposed to politeness and does not recognise basic social conventions.
- Tom's dialect is also broad: 'I passed by yonder she'd have some little somethin' for me to do – choppin' kindlin', totin' water for her' (Ch. 19, p. 211). However, in contrast to Robert Ewell, Tom's dialect is softer. He calls Judge Taylor and Atticus 'suh' and 'Mr Finch', and is the voice of politeness.
- Calpurnia speaks 'coloured-folks' talk' and 'white-folks' talk' (Ch. 12, p. 139), reflecting her background and inherent ways (her grammar gets 'erratic' when she is angry) but also her current position and the lack of education in the black community.
- Atticus, mirroring his personality, speaks courteously, formally but straightforwardly.

CHECKPOINT 40

Harper Lee seems to be implying that the language of the white community is desirable to the black people and that what prevents the black community speaking well is their lack of education (Chapter 12). What do you think about this? Does this attitude reflect the time when it was written?

Different purposes of language

Harper Lee therefore cleverly uses a variety of language for different purposes:

- To create atmosphere
- To reveal character
- To create symbolic structure
- To support and enhance key themes
- To show authenticity
- To provide information
- To make a social comment
- To provide humour or reveal irony

Changes in language

Language is never static. Some of the words Harper Lee used have a different meaning in today's society. The language used to describe black people has changed. Harper Lee and characters like Atticus and Calpurnia referred to black people as 'Negroes' and 'coloured men/women'. Today the term 'black' is a more acceptable term of description for skin colour and the 'Negroes" descendants would now be referred to as 'African-Americans'. People would rarely say/write 'the coloured man' today, perhaps because it was used to designate a separate legal group under Apartheid in South Africa. However, 'nigger', a bad word in the novel and still not generally used by white people, has begun to be used by black people to refer to themselves. Black people are using a word which white people cannot use and therefore claiming exclusive right of usage. They are not accepting the 'white' creation of how or how not to refer to black people, but they are inventing their own terminology. By doing this the black community are creating an insecurity amongst white people as to how to refer to them.

Another noticeable change in language and meaning is in reference to 'coming out'. This has taken on a specific meaning in recent years, but today's meaning and the meaning in the novel are nevertheless linked. Boo's 'coming out' involves him revealing his true person to the condemning outside world and today's usage involves a person no longer shutting away their homosexual identity to a society which is less than accepting. Both have implications of fear, of being different, of making a bold statement by being known.

? DID YOU KNOW?

The use of language in a novel locates it in a certain period. As you are reading, be aware of language that is now redundant or has a different meaning today.

EXAMINER'S SECRET
Always think about the question carefully and work out exactly what you are being asked to discuss.

- You identified which character we know Harper Lee favours from her writing and how she has not broken down the stereotype of the 'White Trash' lower class by her harsh portrayal of Robert Ewell.

FURTHER QUESTIONS

The following questions are common essay titles in examinations and for coursework assignments. Look back at the **How to use quotations** and **Improve your grade** sections and then attempt these essay questions as practice.

1. Why, do you think, did the writer call her novel *To Kill a Mockingbird*?
2. To tell the story the writer uses the voice of her central character. What are the effects of this technique?
3. Describe how Harper Lee portrays the black community in the novel.
4. How effectively does the film of *To Kill a Mockingbird* deal with the main themes of the novel?
5. 'Harper Lee was so desperate to make the reader sympathise with Tom Robinson that she made him an idealised, unconvincing character.' Do you agree with this statement?
6. Choose one or two settings in the novel. Discuss how they reveal character.
7. Does Harper Lee merely describe, or does she criticise?
8. 'A story about childhood.' True or false?
9. Discuss the changes in the relationship between Scout and Jem as the novel progresses.
10. Consider the effects on the author's writing of where and when she lived.

EXAMINER'S SECRET
Always write a plan for every answer. It ensures you answer the question and stops you from waffling and repeating yourself. Also, if you run out of time, you may gain marks from notes in the plan.

LITERARY TERMS

alliteration relating to the texture or onomatopoeic nature of language; words which start with similar-sounding consonants coming close together in the text (so sometimes known as head-rhyme) e.g. Scout suggests a scheme to succeed. Assonance is its vowel equivalent

autobiography the story of the author's life

bildungsroman a novel which describes a character's development from childhood to maturity, focusing on their experience, education and identity

chronology events arranged in the correct sequence of time

colloquialisms ordinary everyday speech, using informal expression and grammar

dialect accent and vocabulary varying by region and social background

epigraph a heading or quotation that writers sometimes use at the beginning of their work as an indication of theme

figurative language elaborate (as distinct from plain) language. Commonly metaphor and simile

first-person narrative stories told by an 'I' figure who is directly involved. This contrasts to the 'omniscient narrator' where the storyteller knows all and stands outside the story

flashback a term borrowed from films. A sudden jump backwards in time to an earlier episode or scene in the story (see 'echoing' in foreshadowing)

foreshadowing close to the idea of prophesying, an instance or reference to an incident coming later in the text. A contrast to 'echoing' (looking backwards)

genre a type of literature, for instance poetry, drama, biography, fiction

imagery language which builds up a picture or image (e.g. by the use of metaphor or simile)

irony when what is said/written is opposite to what is meant

leitmotif see motif

malapropism confused, amusing, inaccurate use of long words, so called after Mrs Malaprop in Sheridan's play *The Rivals* (1775), who refers to another character as 'the very pineapple of politeness' instead of pinnacle (malaprop from the French phrase *mal* – English equivalent, inappropriate)

maxim a short, pithy statement proposing model human behaviour

metaphor something described as being something else and 'carrying over' its associations

motif a repeated theme, image or character which gives the work a symbolic structure. Leitmotif is a repeated phrase

onomatopoeia words which sound like the noise they describe e.g. cuckoo

personification a variety of figurative language where things or ideas are treated as if they were people, with human attributes and feelings

realism an 'accurate' description of things as they 'really' are in 'ordinary' life

regional novel an emphasis on particular geographical customs and speech which have a significant effect on the development of the novel

satire aggressive irony. A humorous attack on human or institutional imperfection. Characterised by a ridiculing of the morally doubtful or absurd by a witty comparison with the ideal, or at least the preferred

simile when one thing is said to be like another, always containing the words 'like' or 'as' – allowing a comparison with things that

symbolism something simple which re… something else more complicated (ofte… quality), e.g. a flag symbolising nationa…

Act One
Act Two
Act Three
Act Five
Act 1 Scene 1 –
'When shall we three meet again?
In thunder, lightning, or in rain?
When the hurly-burly's done,
When the battle's lost and won.'
'Tis unnatural, even like the deed that's done.'
Act 2 Scene 4 –
The forces of Chaos are unleashed upon the world of nature...
'Sleep no more. Macbeth does murder sleep'
Act 1 Scene 3 – A vision of the future appears to Macbeth through the fog and filthy air.
Act 2 Scene 2 –
Macbeth has done the evil deed...
Act 1 Scene 4 –
As a reward for his victory, King Duncan makes Macbeth Thane of Cawdor
Act 1 Scene 5 –
Lady Macbeth conjures up the spirits of evil to give her strength and cruelty – to win Macbeth the throne
Act 2 Scene 1 –
Macbeth is tempted and tortured: Duncan must die
Act 1 Scene 7 – 'But screw your courage to the sticking place And we'll not fail'
Act 3 Scene 3
Macbeth is not safe until Banquo – prophesied as father of kings – is dead...
Act 3 Scene 4 – ...but not forgotten!
Act Four
Act 4 Scene 1 –
'Macbeth shall never vanquished be until Great Birnam Wood to high Dunsinane Hill Shall come against him.'
None of woman born shall harm Macbeth
But Banquo's line will still be kings...
Order is restored with the crowning of Duncan's son, Malcolm
The world is free of a 'dead butcher and his fiend-like queen'
Act 5 Scene 6 –
'Macduff was from his mother's womb untimely ripped'
'Out, out, brief candle! Life's but a walking shadow...'
Birnam Wood is on the move
Scotland rises against Macbeth
Act 4 Scene 2 –
Other murders are committed on Macbeth's orders
Meanwhile:
Act 5 Scene 1 –
'Out, damned sp
MACBETH – CAWDOR – KING HEREAFTER
KING DUNCAN R.I.P.
MACBETH
KING DUNCAN
BANQUO
MACBETH
LADY MACBETH
MACBETH
MACDUFF'S WIFE AND CHILDREN

partly on what sort of people you think the different characters are. Make up your own mind from what has gone on in the play so far.

Act 2 Scene 2

It is night-time. Lady Macbeth leaves the daggers ready for Macbeth to kill King Duncan. Macbeth murders Duncan. They rush back to bed when they hear loud knocking at the castle gate.


Lady Macbeth

Until now Lady Macbeth has seemed very determined and strong. Here she is very much on edge. Although earlier she seemed able to do the most terrible deeds, now she explains that she could not carry out the murder herself because the sleeping Duncan reminded her of her father. This is the first sign of Lady Macbeth's conscience. She, too, seems to realise the wrongness of the murder.

Macbeth has murdered sleep


Macbeth

Macbeth comes in and says he has killed Duncan as he slept. Sleep represents innocence and peace and Macbeth imagines he has also murdered these. Duncan's innocent servants can say 'Amen' in their prayers, but Macbeth cannot. He is terrified because he knows that he can never be forgiven for his crime. Lady Macbeth says these worries are 'brain-sickly'.


Lady Macbeth

Things that are not natural are often connected in the play with madness. When we first met him, Banquo wondered whether he and Macbeth had eaten 'the insane root' when they saw the witches. Later in the play Lady Macbeth's guilt drives her to madness. Here she takes charge of the situation and tells Macbeth to go and wash the blood from his hands. She means the visible blood on his hands, but Macbeth fears for his blood-stained soul. You should compare this with her behaviour in the sleepwalking scene at the start of Act 5.


Sleep

Sleep is described here as 'chief nourisher in life's feast'. Sleep and food are seen as essential parts of nature. Both are needed for life. Macbeth has destroyed this natural order and this is seen again later, when he destroys the calm and order of his own coronation banquet.

Banquo says in Act 2 Sc 1 that all the lights in heaven are out, meaning that the stars are blacked out. The whole of Act 2 takes place in darkness. The darkness is a symbol of the evil which Duncan's murder casts over the whole world.

Scenes 1 and 2 cover the murder of King Duncan. Macbeth pretends to his friend Banquo that he has not thought about the predictions of the witches. **Banquo** has been having bad dreams, but has prayed to heaven for help. Banquo fights the temptation to believe the witches but Macbeth gives way to it. So Macbeth does not know whether the dagger that appears is real or only in his mind.

Macbeth decides to kill Duncan. We see a big difference between his and his wife's behaviour now. Macbeth carries out the murder but is almost hysterical afterwards. In contrast, **Lady Macbeth** seems weak and is a frightened bundle of nerves when Macbeth is doing the murder but is calm and organised afterwards. Macbeth is a man of action but is confused when he loses his sense of right and wrong. Lady Macbeth feels no guilt about persuading Macbeth to murder the king, but she cannot murder him herself.

Act 2 Scene 3

The castle's Porter (night watchman) answers the knocking at the gate. Macduff has come to wake the king but discovers his dead body instead. During the panic and confusion that results, Duncan's sons decide to escape to safety.

The Porter

The comical Porter adds nothing to the plot, but this is not his purpose. Shorter scenes in the play are either a reminder of what has happened so far or a preparation for what is coming. This scene is light-hearted and relieves the tension of the last scene as well as contrasting with the next, when Duncan's murder is discovered.

The gateway to Hell

The Porter pretends to be the gatekeeper in Hell. This was a traditional figure in plays before Shakespeare's time but it has a special importance here. Macbeth's castle has, in a way, become the gateway to Hell. The Porter makes jokes about the perils of drink and about having too much of a good thing; about a farmer who is ruined because of his ambition; about people who destroy themselves because they confuse truth with half-truths (they 'equivocate' between the truth and lies); and about a tailor who was hanged for stealing precious fabric.


Evil

In some ways the Porter's jokes tell us something about Macbeth, who

might feel is also confused; he too has become corrupted (drunk) with evil, will be ruined by having too much ambition, believes too much in the witches' half-truths and he has 'stolen' the king's crown.

A rough night


Duncan

Macduff and Lennox have come to wake the king. They describe the storm during the night. The description of the storm is symbolic of the effect that Duncan's murder is already having on the world around. The murder of the king has filled the night with screams of death and other portents. Notice how sickness seems to have infected even the earth itself, when Lennox says that he has heard that the earth 'was feverous and did shake'. Macbeth agrees ironically that "twas a rough night'.

The murder is discovered


Chaos


Sleep

Notice the imagery which Macduff uses when he tells the others that he has found Duncan murdered. This goes beyond the mere facts about the murder. The murder has unleashed chaos (confusion) on the world and is sacrilegious (against God). Macduff says that to look at the murdered body will 'destroy your sight with a new Gorgon'. (The Gorgons were female Greek monsters who were fierce and unpleasant, with live snakes for hair, huge teeth and brass claws. Note that the only women you have met so far in the play are the witches and Lady Macbeth.)

Macduff describes sleep as an imitation ('counterfeit') of death and tells Banquo to rise up like a 'sprite' (a ghost) from its 'grave' (his bed) to look at 'this horror'. Later in the play Banquo's ghost rises from the dead to visit another 'horror' when it returns to haunt Macbeth.

Macbeth pretends that life now has no meaning for him


Chaos

Images of blood and water appear again in Macbeth's speech 'Had I but died an hour before this…', which you should read carefully. It is a prophetic speech. Death does become unimportant to Macbeth and he is indeed no longer 'blessed'. Decide whether you think Macbeth is just saying these words because he feels that the others expect him to say something like this or whether you think he really means them.


Time

Near the end of the play Macbeth says something similar, although there he speaks his real feelings (look at Macbeth's soliloquy in Act 5 Sc 3, starting with 'Take thy face hence').

Duncan's guards are suspected

Lennox says it appears that Duncan's guards have done the murder. Macbeth says he was so angry when he saw Duncan's body that he killed the guards. This is a tricky moment for Macbeth. The others would have wanted to question the guards. After all, the king's army has only recently fought off an invasion from abroad which was helped by traitors within Scotland. The guards might have been working for another enemy of Scotland. Macduff wonders why Macbeth should have destroyed the only way of finding out. Of course, Macbeth knows that the guards would have denied the murder because they were innocent. There was a risk that they might have been believed. Lady Macbeth faints just at the right moment, but it may have been too late to save Macbeth from suspicion. This killing of the grooms is also the first sign that Macbeth is about to go his own way; this was not part of the plan!


Chaos

Malcolm and Donalbain are afraid


Malcolm

Duncan's sons Malcolm and Donalbain decide to escape in case they too are targets to be murdered next. Donalbain does not appear again in the play but he leaves with a telling remark about how there are 'daggers in men's smiles' all around them, echoing the 'fair is foul' theme of the play.

Act 2 Scene 4

Ross, Macduff and the Old Man discuss the current situation.


Chaos

This is another scene, like the one with the Porter, where the audience gets the chance to digest what has happened so far. Ross and the Old Man give simple, honest reactions to events and fill in the story. Stress is laid on the unnaturalness of the murder and how it has begun to poison all nature. Darkness 'strangles' the daylight, birds of prey are killed by the creatures they normally hunt and Duncan's horses have turned wild and eaten each o

Macbeth becomes king

Macduff joins them. In answer to questions he says that because Malcolm and Donalbain have fled, they are suspected of having paid the guards to do the murder. Ross mentions another one of the main themes in the play when he comments that people's 'thrifteless ambition' will foolishly destroy and consume the very thing on which their life and future depend. Meanwhile Macbeth has hurried off to be crowned. Macduff hopes that the country's 'old robes' (King Duncan) do not turn out to 'sit easier' (be more comfortable) than 'the new' (King Macbeth). He hopes for everybody's sake that Macbeth will not turn out to be a bad king.

Clothing

The murder of Duncan provokes wild happenings in the world of nature with storms, earthquakes and unnatural behaviour in animals. When the murder is discovered, Macbeth and Lady Macbeth try to avoid becoming suspects. Macbeth says that his life now has no meaning and that he feels cursed because the king has been murdered. It seems likely that he really means at least some of this and that he does not say it entirely for show.

Lady Macbeth drugged Duncan's guards and smeared them with Duncan's blood as they slept. Macbeth has swiftly killed them to stop them saying anything about the murder. Lady Macbeth pretends to faint when Macbeth is asked an awkward question about this.

Duncan's sons Malcolm and Donalbain decide to escape. They are afraid for their safety. When they disappear, suspicion does fall on them and it is thought that they have run away because of guilt.

Macbeth seems to have achieved his ambition when he is crowned king. The Old Man, Ross and Macduff discuss the terrible events and hope that things will now improve. Macduff says that he is not going to Macbeth's coronation but plans to go home instead. He raises the possibility that Scotland may suffer under Macbeth.

■ Self-test (Questions) Act Two

Uncover the plot

Delete two of the three alternatives given, to find the correct plot. Beware possible misconceptions and muddles.

Banquo and his son Young Siward/Ross/Fleance meet Macbeth, who claims to have dreamed about/not to have thought about/to have served the Weird Sisters. Alone, Macbeth sees a bloody crown/child/dagger and goes to kill Duncan/Banquo/Macduff. Unnerved by the sound of a bell/owl/scream, Macbeth describes the deed: he could not say 'Amen'/'God bless us'/'Murder!', has heard a voice crying 'Glamis hath murder'd Duncan/the King/sleep!' and thinks his hands/daggers/clothes will never be clean of blood. Early, the body is discovered by Lennox/Banquo/Macduff. Malcolm and his brother Ross/Donalbain/Macduff are suspicious and afraid: the heir to the throne flees to England/Ireland/Scone.

Who? What? Where? Why? How?

1 Who is on night watch at the castle, as the Act opens?
2 Who says he does not want to sleep, though tired – and why?
3 What happened during the night, according to Lennox, and according to Ross and the Old Man?
4 What vision does Macbeth see, and how does he interpret it?
5 Where do Malcolm and Donalbain escape to?
6 Where is Macbeth invested (crowned) as king – and who is noticably absent?
7 Why did Macbeth kill Duncan's guards, why does he say he did so – and how does he get out of having to explain more fully?
8 Why can't Lady Macbeth not kill Duncan herself?
9 How do the sounds of a bell and knocking connect in Macbeth's mind with Duncan's death?
10 How do the Porter's anecdotes reflect on the action of the play?

Who said that?

1 Who says: 'I am afraid to think what I have done;/Look on't again I dare not'?
2 Who says: 'My hands are of your colour; but I shame/To wear a heart so white.'?
3 Who says: 'In the great hand of God I stand, and thence/Against the undivulg'd pretence I fight/Of treasonous malice.' – and why is this ironic?
4 Who says: 'Adieu,/Lest our old robes sit easier than our new'?
5 Who says: 'Where we are,/There's daggers in men's smiles'?

Open quotes

Find the line – and complete the phrase or sentence.

1 'Or art thou but a dagger of the mind...'
2 'But wherefore could not I pronounce "Amen"?...'
3 'Will all great Neptune's ocean...'
4 'There's nothing serious in mortality...'
5 'Tis unnatural...'

Night moves

This Act is full of actions and images to do with sleeping, waking and wakefulness: they will become even more significant as the play goes on. Find three lines in the text on each of the following themes.

1 Sleep and death
2 Sleeplessness
3 Waking and summoning from sleep
4 Dreams and nightmares

Quotations you should know

Brave Macbeth – well he deserves that name –
Disdaining fortune, with his brandished steel,
Which smoked with bloody execution,
Like valour's minion carved out his passage Act 1 Sc 2

So foul and fair a day I have not seen. Act 1 Sc 3

If it were done when 'tis done, then 'twere well
It were done quickly. If the assassination
Could trammel up the consequence, and catch
With his surcease success – that but this blow
Might be the be-all and the end-all! Here,
But here, upon this bank and shoal of time,
We'd jump the life to come. Act 1 Sc 7

I dare do all that may become a man;
Who dares do more is none. Act 1 Sc 7

Will all great Neptune's ocean wash this blood
Clean from my hand? No, this my hand will rather
The multitudinous seas incarnadine,
Making the green one red. Act 2 Sc 2

Had I but died an hour before this chance
I had lived a blessèd time; for, from this instant
There's nothing serious in mortality. Act 2 Sc 3

It will have blood, they say; blood will have blood. Act 3 Sc 4

I am in blood
Stepped in so far, that, should I wade no more,
Returning were as tedious as go o'er. Act 3 Sc

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Self-test (Answers) Act Five

Uncover the plot
The doctor, after two nights of vigil, sees for himself how Lady Macbeth walks in her sleep, preoccupied with blood on her hands. The English, under Malcolm's uncle Siward, are meeting at Birnam. Macbeth is aware that he is unpopular, but resolute – and worries about Lady Macbeth. Following Malcolm's ploy, Macbeth learns that Birnam Wood is moving. As battle is joined, he has no time to grieve that Lady Macbeth is dead. We see Macbeth kill Siward's son, before dying at the hands of Macduff. The play ends with the rightful king to be crowned at Scone.

Who? What? Where? Why? How?
1 Macduff 5,7
2 Malcolm 5,7
3 Walks with a candle, eyes open, writes on a paper, seals it and returns to bed 5,1
4 She needs a priest (divine) not a doctor: it is her conscience. 5,1. The patient must cleanse her own conscience 5,3
5 In the front – because this shows he has been fighting, not fleeing 5,8
6 Dunsinane – because this is in the prophecy of his defeat 5,1
7 He has 'supped full with horrors': 'direness' is familiar to him 5,5
8 Because he has shed too much of his family's blood already 5,8
9 Branches from the wood are used as camouflage for the approach to the castle 5,5
10 He was not born of woman, but was taken early from his mother's womb 5,8

Who said that?
1 Lady Macbeth 5,1
2 Caithness 5,2
3 Macbeth 5,3
4 Macbeth 5,5
5 Malcolm. It suggests that under his kingship virtue and proper order will be re-established 5,8

Open quotes
1 'Here's the smell of the blood still…All the perfumes of Arabia will not sweeten this little hand.' 5,1
2 'And that which should accompany old age,/As honour, love, obedience, troops of friends/I must not look to have.' 5,3
3 'Tomorrow and tomorrow and tomorrow,/Creeps in this petty pace from day to day/To the last syllable of recorded time.' 5,5
4 'I pull in resolution and begin/To doubt th'equivocation of the fiend/That lies like truth.' 5,5
5 'And be those juggling fiends no more believ'd/That palter with us in a double sense.' 5,8

Parallel lines
1 Lady Macbeth cannot get the stain from her hands 5,1, and Macbeth is said to 'feel/His secret murders sticking on his hands' 5,2. Macbeth was right to fear that the blood would never come off
2 The rebels have 'To dew the sovereign flower and drown the weeds' 5,2. Macbeth has grown – but, ironically, as a choking weed
3 Macbeth says: 'Life's but a walking shadow, a poor player' 5,5. Whether or not he was partly honest in his sentiments after Duncan's death, he has fulfilled his own prophecy
4 'Now does he feel his title/Hang loose about him, like a giant's robe/Upon a dwarfish thief.' 5,2. Ironically, it was Macbeth himself who first used this image of reluctance and ill-suitedness

General questions on the whole play
Here are some suggestions.
M Murder, morality, madness, medicine
A Ambition, ambiguity, animals
C Clothing, chaos, children, conscience, crown, cowardice, curse, courage
B Blood, bravery, bathing
E Equivocation, evil
T Time, trust, tiredness, tyranny
H Hospitality, hesitation, holiness, horror, health, honesty, honour, hope
S Sleep, sickness, storms, state, savagery, sleeplessness, safety, supernatural, seeds
O Order, owls
L Light, loyalty
D Deception, determination, dreams, damnation, doom, disorder, darkness, death, doubt

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Setting - Where it Happens

The play takes place round about the 16th Century.

Most of the events are set in the City of Venice - Italy.

Antonio, Shylock and Bassanio carry on their business in Venice

The remainder of the action takes place in Belmont - meaning Beautiful Mountain.

Belmont is a short distance away from Venice, and it is where Portia lives.

The Bare Facts of the Story

Friendship & Love

contrasted with

Money & Greed

1. Bassanio, a young Venetian gentleman, wants to marry Portia, a wealthy heiress.
2. To do so, he needs money and asks his close friend, Antonio - the Merchant of Venice, to help him. Antonio's wealth is tied up in ships trading overseas.
3. So Bassanio arranges to borrow from Shylock - a Jew, and Antonio guarantees the loan.
4. The guarantee (bond) requires Antonio to forfeit one pound of his flesh to Shylock if the loan is not repaid within three months.
5. Bassanio uses the money to pursue Portia, and wins her hand in marriage.
6. Antonio fails to repay the loan in time and Shylock takes him to court.
7. Portia, disguised as a lawyer, successfully defends Antonio. As a result, Shylock will eventually lose his wealth and must become a Christian.

Fill in the blanks

The Merchant of Venice is _____. Much of the play's action takes place in _____ where _____ carries on his business as a money lender.

The story gets its impetus from the fact that _____ wants to marry a wealthy heiress, called _____. He feels he cannot pursue her because he has no _____. Already in debt to _____, he asks him for yet more help.

_____ has no spare cash, so _____ arranges a loan with _____.

The loan is for _____ ducats, and must be repaid within _____ months. Otherwise, _____ can cut a _____ of _____ from any part of _____'s body.

Meantime, _____ has travelled to _____, and in competition with other nobles, the Princes of Morocco and _____, has won the hand in marriage of _____.

Antonio's _____ are lost and he cannot repay the loan. Taken before the Duke of _____ he is to be tried. Secretly, on hearing this news, _____ and her maid _____ travel to _____. She successfully defends _____. _____ is devastated. Can you complete this quotation from Shylock? 'I pray you, give me leave to go from hence. I am not _____.' (4.1.391)

Characters - Antonio

The bare facts:

1. Antonio is the *The Merchant of Venice* of the play's title.
2. He is a wealthy man, but sad and lonely.
3. At the time of the play he is short of cash, but not all his money is tied up in current ventures (1.1.40).

He represents:

The Renaissance ideal of the perfect Christian gentleman. Note that his treatment of Shylock would not have seemed strange to his audience, though it does to us.

A question to consider:

Antonio is a mature person, though he is never seen in the company of similar men. Is this because of his love for Bassanio, whose company he does keep, and whose friends are therefore also his?

A sad, lonely figure:

In sooth, I know not why I am so sad. 1.1.1
I hold the world . . .
A stage where every man must play a part,And mine a sad one. 1.1.17

In Venice, as the play begins, he is a lonely figure, sad and depressed (1.1.1) - perhaps this should warn us (is an omen) of times to come?

I am the tainted wether of the flock
Meetest for death 4.1.113

He doesn't understand his own sadness (1.1.7) and thinks maybe this is his lot in life (1.1.77). Patient in the face of misfortune (4.1.10), he is resigned to his fate (4.1.114).

His sadness is recent (1.1.75), and possibly arises from his love of Bassanio, and the fact that he is probably going to lose him to Portia - his first words to Bassanio are about Portia (1.1.119).

In Belmont, at the end, Portia has saved his life, and brought news that his living (his ships) are safe. But he is noticeably still alone (5.1.286).

Characters - Antonio

Antonio's attitude towards Shylock:

We never see him spit on or kick Shylock, though he has obviously done so (1.3.103), and says he will do it again (1.3.126).

'I am as like to call thee so again,
To spit on thee again,
. . .' (1.3.126)

If we saw this happen on stage would it change our attitude towards Antonio? If so, why and in what way(s)?

Menorah
(Check this out in a good dictionary)

Note that Antonio's attitude towards the Jews and their nation would not be seen as strange in Elizabethan England - see the history/ background section in this book.

Antonio shows 'mercy' when he does not immediately take all of Shylock's money and even greater mercy, in Elizabethan eyes, when he requires him to become a Christian! (4.1.377)

Shylock on Antonio:

Shylock hates Antonio because he is a Christian and complains about Shylock's business practices (1.3.38).

He insultingly says Antonio looks like a 'fawning publican' - a humble tax collector (1.3.38).

He mainly hates Antonio for lending money without charging interest (1.3.41).

The depth of hatred is seen when Jessica reports he 'would rather have Antonio's flesh' than twenty times the bond amount (3.2.284).

Useful quotations to remember:

My ventures are not in one bottom trusted,
Nor to one place 1.1.42

My purse, my person my extremest means,
Lie all unlocked to your occasions. 1.1.138

The devil can cite Scripture for his purpose. 1.3.95

O, what a goodly outside falsehood hath! 1.3.99

My soul upon the forfeit, 5.1.250

Questions About Characters

It's not that hard to gather a heap of information about particular characters. If you do, it means you'll have a much better chance of getting to the heart of an exam question quickly and efficiently.

Character Questions Are the Examiner's Favourite

Questions about characters are the most popular.

It's pretty obvious why, really — characters act out the story, and shape the plot. Their actions and experiences are what stories are all about — they come into everything. You need to be able to write about them confidently if you want to get good marks.

Make Sure You Prepare For Character Questions

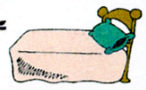
Make revision notes on these things for the texts you're studying — then you'll be sorted for any exam question on characters. Not all of these will apply to all stories — pick the ones that fit best.

Q. Why is a certain character important?	How do they affect the plot? Do they represent a particular point of view? What might happen if they weren't there?	→ *Bilbo, Lord of the Rings* WITHOUT HIM, THE RING WOULD NEVER HAVE BEEN FOUND
Q. Does the character change over the course of the story?	Does their personality change? Do they get better / worse? Do they behave differently?	→ *George, Of Mice and Men* HE KILLS LENNIE AT THE END
Q. What has a character learnt by the end?	Have they learnt a valuable lesson? Have they learnt anything? What implications does this have?	→ *Scrooge, A Christmas Carol* HE LEARNS TO BE KIND
Q. How does the writer reveal a character's personality?	Is there a conflict between what we think of them and what other characters think of them? How do their experiences come across to the reader?	→ Main Character, *Superman and Paula Brown's New Snowsuit* ONLY WE KNOW THE TRUTH
Q. How are characters similar to or different from each other?	How do characters relate to each other? Do differences bring about events in the plot? What does the writer want these things to show us?	→ Father and daughters, *Growing Up* THEY'RE GROWING APART
Q. Do you like/sympathise with a certain character?	Why do you feel this way towards the character? How does your opinion of this character affect the story? What has the writer done to make you like/dislike them?	→ The Mother, *Your Shoes* FEEL SYMPATHY AND DISLIKE AT ONCE
Q. What does the writer want us to think about a character?	Is there more than one way to feel about the character? How does the narrator shape our opinion? How does the author orchestrate the story, so we have that opinion?	→ Any of the above and more...

This ISN'T so you can pre-plan essays — that's ridiculous. You can't tell what the questions will be. It's just so that you've prepared the background, and have the best possible chance.

Yaaaaaaaaaaaaaaaaawn —this is exhausting stuff...

Well at least this is the last page of the section. And look, I've even brought you a nice comfy bed so you can have a quick nap before continuing.



Answering Literature Questions

It's not just writing a book review, you know. There are different types of literature questions and you need to know how to answer all of them. Come on, it's only a few pages — how bad can it be...

Step 1 — Work Out What The Questions Are About

1) You have to answer the question properly to get a decent grade.
2) The first thing to do is work out what the question is about.
3) The two subjects that come up time and again are the writer's message and the characters:

This one's about the WRITER'S MESSAGE.

The 'message' is the moral, or just an opinion the writer's got about what they're writing about. There's more about this on Page 14.

→ In *The Three Little Pigs* the Wolf dies at the end. What do you think the writer is trying to say about the behaviour of the three pigs?

This one's about one of the CHARACTERS.

More about character questions on Pages 12 and 13.

→ How does the writer bring out different traits of the Wolf?

4) For the 'different cultures and traditions' question in the English exam, you'll also have to write about the writer's background, and how it links with the poem or story. (See P.15)

Compare *The Enormous Turnip* with *The Enormous Beetroot* showing how the writers reveal their ideas and feelings about the cultures in which they have set their stories.

5) Once you know what the questions are about, you're ready to choose between them.

Step 2 — Choose the Question That's Best For You

1) You always get a choice with literature questions.
2) There's usually a choice of two questions on each book.
3) For questions on stuff from the Anthology you could get a choice of three questions.
4) Obviously you want to choose a question that you can answer really well, but in the hot sweaty panic of the first few minutes of the exam, it's easy to make a duff choice.
5) Don't panic. Take a deep breath, and then choose:

- A question which gives you lots of IDEAS on what to write about.
- A question which is on material you're FAMILIAR with. (i.e. you've read the book, the poems or the stories)
- A question which you definitely UNDERSTAND.

6) If you're doing coursework this isn't such a big deal. Just make sure you understand the question before you stay up all night writing your essay.

Choose wisely you must...

Hmmm... choices... Look, just PICK THE EASIEST ONE. Loads of people go wrong by picking the most interesting one, then find out it's rock hard once they start writing. Don't fall into that trap.

Reading Plays

You need to know how plays are different from books and poems to write about them properly. You can lose a whole barrel of marks if you ignore the fact that the text is a play.

Plays Can Be Serious or Funny

Tragedy

1) Tragedy is the most serious kind of play and is about big topics — e.g. religion, love, death, war.
2) Tragedies are meant to be really moving and often have a moral message.
3) Older tragedies are set in an imaginary or past world. The characters are often kings and queens or even gods and goddesses.

Comedy

1) Comedies are supposed to make you laugh.
2) Events and characters are based on things that happen in real life, but are much more silly and exaggerated.

Don't forget History Plays — They're any kind of play based on real historical events — dead popular with Shakespeare.

Dialogue is One Character Talking to Another

Write about dialogue to show how characters react. It looks like this on the page...

LORD CRUMB:	Where exactly is the pizza?
VERNON:	In the basement, my lord.
LORD CRUMB:	Very good, Vernon.

If two or more people talk to each other it's called dialogue.
If one person speaks for a long time it's called a monologue.
If one character stage-whispers to the audience, but other characters can't hear, it's called an aside.

VERNON: (aside) Well, it's not there yet, but it will be in 10 minutes.

It's easy to spot because it says "aside" after the character's name.

A Soliloquy is Thinking Out Loud

A soliloquy only involves one character (like a monologue). The character doesn't talk to anyone — they're just thinking out loud. Only the audience can hear what they're saying — other characters can't hear a thing.

Stage Directions Give More Detail About the Story

You can write about stage directions — they tell you a lot about how the playwright wanted the play to look.

STAGE DESIGNS — scenery, lighting, special effects

A cluttered attic room: stuffed bear, upright piano, pot plants. Moonlight filters through a dirty window.

The room is dirty and cluttered, so it sounds as if it's not well looked after.

ACTION

Unseen by Lord Crumb, Vernon slides the pizza into an envelope and conceals it beneath a cushion on the couch.

DIALOGUE — little details about how the actors say their lines

LORD CRUMB:	I was wondering...
VERNON: (interrupts)	RUN!!!

I used to know a drama queen — but my parents disapproved...

If you ask me, soliloquy is a ridiculous sort of a word. It's not easy to spell, it looks odd, and yet all it means is talking to yourself. Who'd want to do a thing like that, eh?

Language in Shakespeare Texts

Shakespeare's language can seem a bit daunting — but don't be afraid, my little balls of fluff. Examiners are impressed if you use the right words, so even a little goes a long way.

Show You're Aware of How Old (and Weird) It All Is

1) Shakespeare's plays are about 400 years old, so it's not surprising the language is a bit strange.
2) The sense of humour was different too — lots of the jokes are puns (words with double meanings).
3) They also thought the idea of girls dressing up as boys was funny (basically because all the actors in Shakespeare's time were men, so boys dressed as women dressed as boys — get it?).
4) Mention the different sense of humour to show that you're aware of when the play was written.

Be Specific When You Write About Language

Shakespeare wrote in a mixture of poetry and prose. You can write about whether people are posh or common, and are serious or joking around — just by looking at the form they speak in.

Poetic Verse is the Most Dramatic — and It Rhymes

1) Poetic verse is definitely the most dramatic one of the lot.
2) You can spot it easily because it has 10 or 11 syllables in each line and it rhymes.
3) It sounds more impressive than the rest of the text, and is used especially by the posh characters and at the beginnings and ends of scenes.

From forth the fatal loins of these two foes
A pair of star-cross'd lovers take their life,
Whose misadventur'd piteous overthrows
Doth with their death bury their parents' rage.

Romeo and Juliet The Prologue

Blank Verse Doesn't Rhyme

1) This is just like poetic verse, only harder to spot because it doesn't rhyme (but still has 10 or 11 syllables).
2) It sounds grander than plain old prose, but any of the characters can speak in it.
3) The majority of the lines are written in it.

If music be the food of love, play on;
Twelfth Night

Wilt thou be gone? It is not yet near day.
Romeo and Juliet

Badger V
The badger laughs when'er he lets one rip.

Prose Can Be Spoken By Anyone

1. The rest is written in normal prose, like this paragraph. Prose is mainly for minor characters, although anyone can talk in prose.
2. It's for general chatting, larking about or bits that just move the plot along, and aren't particularly meaningful.

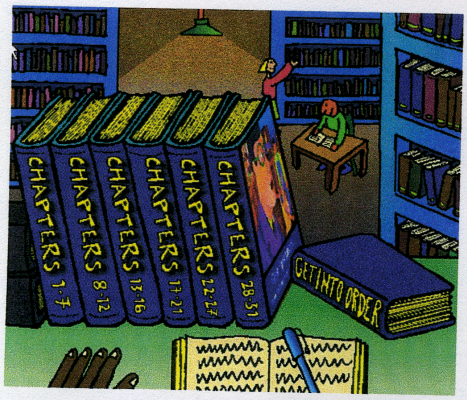
FESTE: Vent my folly! I am afraid this great lubber, the world, will prove a cockney. I prithee now, ungird thy strangeness and tell me what I shall vent to my lady.

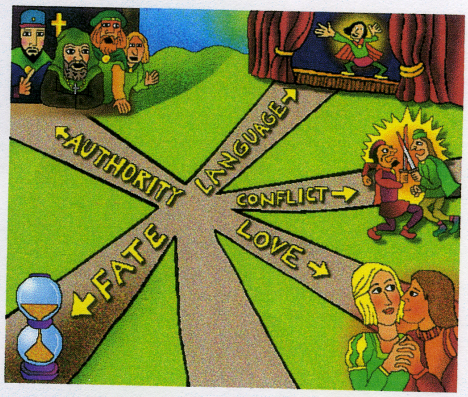
Twelfth Night Act 4 Scene 1

Language — no phonecall would ever be the same without it...

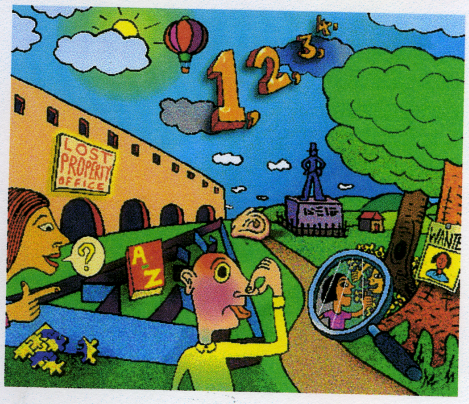
If you can just get all these terms out quickly and efficiently (and in the right places, obviously) — the examiner will know you've got it sussed. And he'll give you a big ol' mark to show it.

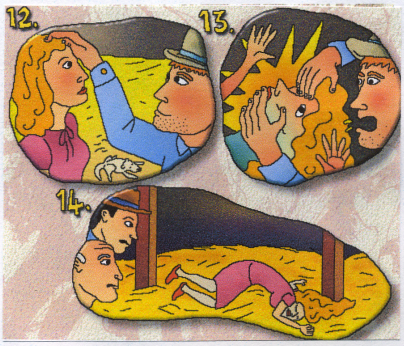

Story
Characters
Themes
Text
Background
Quiz
Tracker
Internet
Exit
THE BIBLE
THE CORAL ISLAND
Background to
THE TEXT

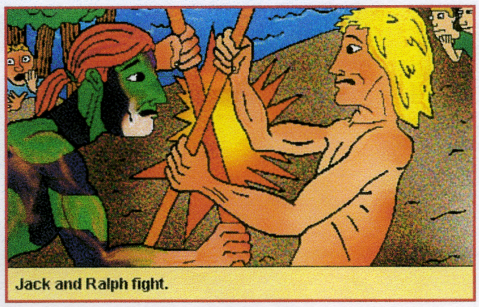

CHAPTERS 1-7
CHAPTERS 8-12
CHAPTERS 13-16
CHAPTERS 17-21
CHAPTERS 22-27
CHAPTERS 28-31
GET INTO ORDER

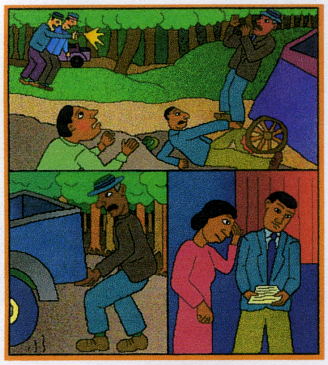

AUTHORITY
LANGUAGE
CONFLICT
LOVE
FATE


SOURCE


1
2
3
LOST PROPERTY OFFICE
A
Z

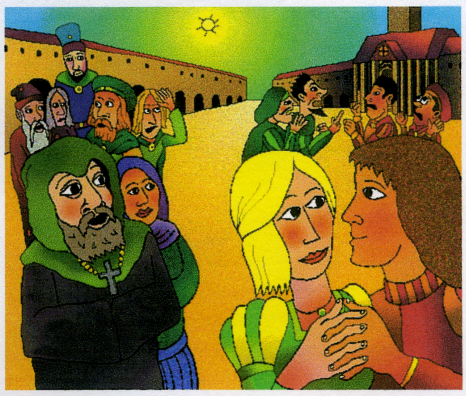

12.
13.
14.

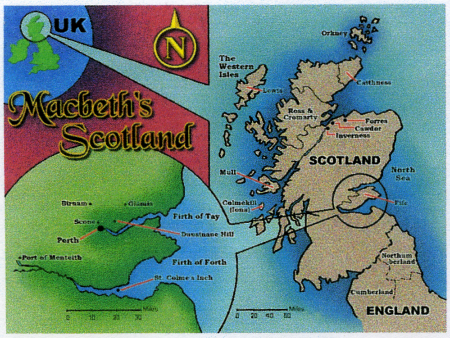

Jack and Ralph fight.

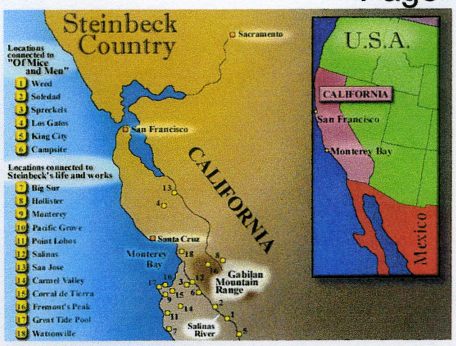


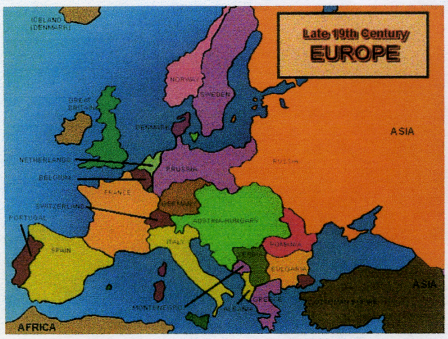

21.
22.


7.
8.
9.

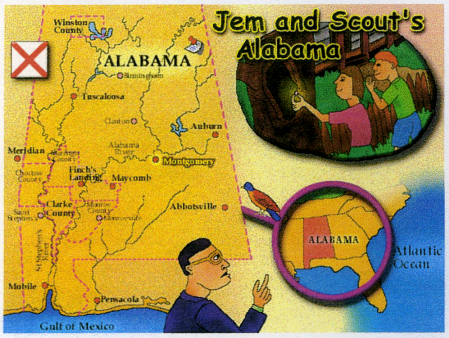


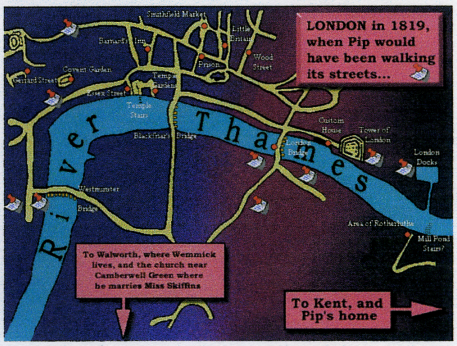

UK
Macbeth's Scotland
SCOTLAND
ENGLAND
Firth of Tay
Firth of Forth
Perth
Inverness
North Sea

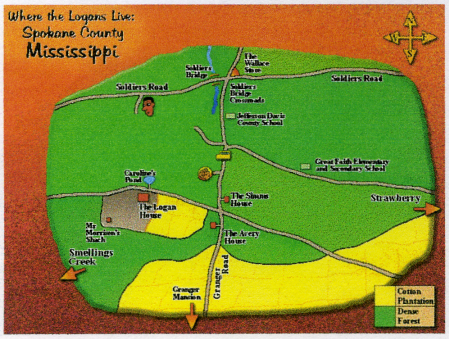

Steinbeck Country
U.S.A.
CALIFORNIA
San Francisco
Monterey Bay
Mexico
Sacramento
Locations connected to "Of Mice and Men"
Weed
Soledad
Spreckels
Los Gatos
King City
Campsite
Locations connected to Steinbeck's life and works
Big Sur
Hollister
Monterey
Pacific Grove
Point Lobos
Salinas
San Jose
Carmel Valley
Corral de Tierra
Fremont's Peak
Great Tide Pool
Watsonville
Santa Cruz
Monterey Bay
Gabilan Mountain Range
Salinas River

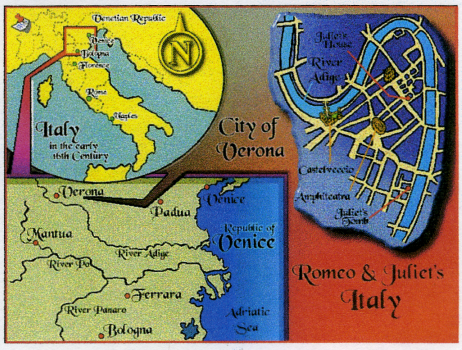

Late 19th Century
EUROPE
ASIA
AFRICA


The Island
Pacific Ocean
The signal fire
The "back home" of the island
The "unknown" side of the island
Castle Rock
Lagoon
The Reef


Jem and Scout's Alabama
ALABAMA
Winston County
Tuscaloosa
Auburn
Montgomery
Maycomb
Abbotsville
Meridian
Mobile
Pensacola
Gulf of Mexico
Atlantic Ocean


LONDON in 1819, when Pip would have been walking its streets...
River Thames
To Walworth, where Wemmick lives, and the church near Camberwell Green where he marries Miss Skiffins
To Kent, and Pip's home


Where the Logans Live:
Spokane County
Mississippi
Soldiers Road
The Logan House
Strawberry
Smellings Creek
Granger Road
Granger Mansion
Cotton Plantation
Dense Forest


Italy
in the early 16th Century
City of Verona
Romeo & Juliet's Italy
Verona
Padua
Venice
Mantua
River Adige
River Po
Ferrara
River Panaro
Bologna
Adriatic Sea
Republic of Venice

a) He is the first character to speak in the novel. — True / False

b) It's his idea to have a vote to elect who should be the Chief. — True / False

c) He violently splashes Ralph's face with water. — True / False

d) He claims not to have seen the murder of Simon. — True / False

Click a True/False 'light' to indicate your choice.

Which THREE mark Jem's growing maturity?

a) What he tells Scout to do with the roly-poly.

b) What he learns about ancient Egyptians.

c) What he does when the mob appear outside the jail.

d) His reaction to Mrs Dubose's gift.

e) The way he runs past the Radley place.

a, b and e

a, b and c

a, c and d

c, d and e

Click a box to indicate your choice.

Page 3 of 5

Aunt Alexandra has come to stay because, she says, the children need some _____. Although her brother, _____ tries to fit in with the way she wants to do things, he refuses when she wants to get rid of _____.

Scout is astonished one evening to discover _____ under her bed and feels that ___ breaks one of their childhood codes of honour when he tells Atticus about this.

When Atticus is sat one evening outside the jail where _____ is being held, a lynch mob of men turn up from _____. They have come to act as judge, jury and executioner themselves, but the mob breaks up and goes home after Scout gets Mr _____ talking and the tense atmosphere is broken.

Page 1 of 1

The main families and individuals in the action of the book are outlined below. Other characters who appear in the story but not usually as part of an organised family grouping have not been included here.

The Finch family:
This is composed of Atticus Finch, a widower lawyer, and Jean Louise [Scout] Finch and Jeremy [Jem] Finch who are his children. Calpurnia, the black cook, is treated as a family member and acts as the children's surrogate mother. Calpurnia grew up next to Finch's Landing and moved to Maycomb when Atticus got married. Calpurnia's eldest son is Zeebo, who is the town's garbage collector and the music superintendent at First Purchase Church.

The sister of Atticus, Aunt Alexandra, leaves her husband

Page 1 of 1

Who's going to join my tribe? →

He hates me. I dunno why. →

What else is there to do? →

That's not the way. →

Be sucking my thumb next — →

I know. Jolly good show. Like the Coral Island. →

You let the fire out. →

Page 1 of 1

Which of these is correct?

It's his idea to make a fire. — True / False

He is the first to see the smoke on the horizon. — True / False

He thinks Castle Rock is a good place. — True / False

He stands on his head. — True / False

He is the one who first thinks that they should build shelters on the beach. — True / False

How well do you know the character(s)? Click in the blue box and type in your answer.

Name the one who crawled into a shelter and stayed there for two days.

Name one of the two smallest ones on the island.

Where did Percival say the beast lived?

Who at the end cannot remember his address?

Which one had stones thrown at him by Roger?

Can you score 5 correct without guessing? Type a Chapter number in a box, and hit enter to register your choice. Keep checking your score with the 'tick' button at the top of the screen.
There are 12 Chapters in the story.

Chapter?

Simon 'talks' to the Lord of the Flies.

Jack apologises for his behaviour.

Jack says the hunters will look after the signal fire.

The dead airman is freed and drifts out to sea.

The boys vote on " whether there may be ghosts ".

Page 2 of 2

We never learn Piggy's real name. We know he is fat, wears glasses and has many other physical problems. Because of this he tends always to have been an 'outsider' at school. For him, life on the island turns out to be much the same.

Although he isn't popular with many of the others, Piggy is a strong and logical thinker whom Ralph slowly comes to admire and be friends with.

Piggy is one of the few characters in the story who shows care and compassion for others. Sometimes he is very courageous in standing up against things which he thinks are wrong.

The Coral Island

Search

PREFACE Back Next

The Coral Island
A Tale of the Pacific Ocean

R. M. Ballantyne

I was a boy when I went through the wonderful adventures herein set down. With the memory of my boyish feelings strong upon me, I present my book specially to boys, in the earnest hope that they may derive valuable information, much pleasure, great profit, and unbounded amusement from its pages.

One word more. If there is any boy or man who loves to be melancholy and morose, and who cannot enter with kindly sympathy into the regions of fun, let me seriously advise him to shut my book and put it away. It is not meant for him.

Treasure Island

'Treasure Island' was written in 1883 by Robert Louis Balfour Stephenson (1850 - 1894), who was born in Edinburgh, Scotland.

Because 'Treasure Island' is a novel about adventures on a desert island it would have sprung to mind as a comparison when Golding's readers first read 'Lord of the Flies'.

But Stephenson's intentions in writing his novel were very different to those of Golding. Stephenson was far more concerned with providing sheer entertainment than Golding, who consciously wrote a modern fable which he meant to 'sugar the pill' of the unpleasant message he wanted his readers to receive and learn from.

Year Chapter and Events

1933 1 Dill, Jem and Scout spend their first Summer together
2 Scout's first day at school - September
3 Burris Ewell attends school
Walter Cunningham visits Scout's home for lunch
1934 4 Gifts begin to appear in the tree outside the Radley place
5 The children are caught with their note to Boo
6 Jem loses his pants in the Radley's yard, but returns to find that they have been mended

Page 1 of 1

Commentary

Search

The Sound of the Shell Back Next

Chapter 1
Paragraph beginning: He jumped down from the terrace.

The forces of nature on the island begin to exert an influence on the boys at once. It's too hot to keep their clothing on. At first they are happy to throw off their clothes, thinking them restrictive. But later they feel differently about this new freedom to do what they like - compare this scene here with their feelings in Chapter 11, when both Ralph and Piggy feel the need to put clothes on. Wearing clothes by then has come to remind them of happier times when the world seemed more normal and orderly. There is also a hint here that everything on the island may not be as wonderful as it seems at first. The island may look like The Garden of Eden, but the fruit gives them diarrhoea.

quotation

The Text

Back to Commentary

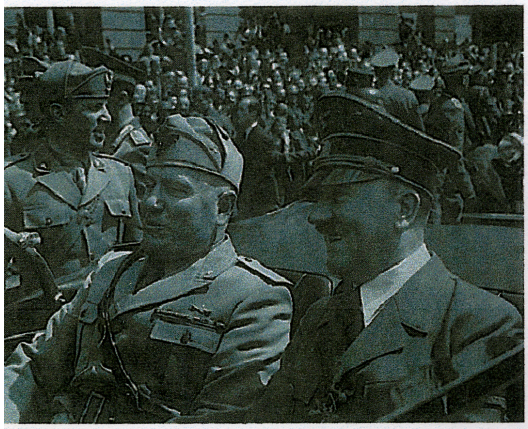
Search

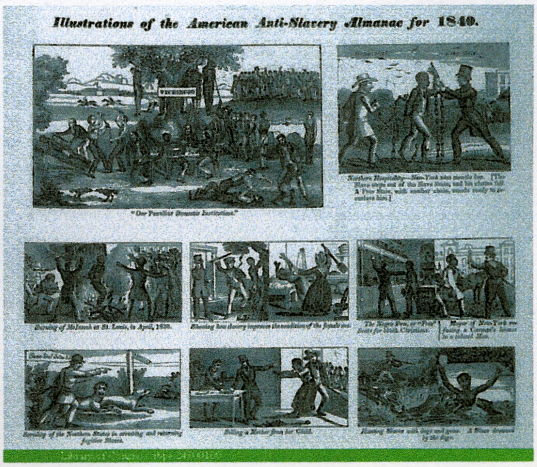
Act 3 Scene 2 Back Next

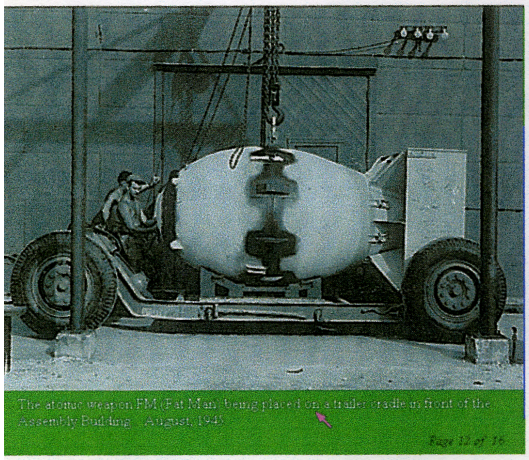
Act 3 Scene 2
Capulet's orchard.

Enter Juliet alone.

Juliet Gallop apace, you fiery-footed steeds,
Towards Phoebus' lodging! Such a wagoner
As Phaeton would whip you to the West
And bring in cloudy night immediately.
Spread thy close curtain, love-performing night,
That runaway eyes may wink, and Romeo
Leap to these arms untalk'd of and unseen.
Lovers can see to do their amorous rites
By their own beauties; or, if love be blind,
It best agrees with night. Come, civil night, 10
Thou sober-suited matron, all in black,
And learn me how to lose a winning match,







The atomic weapon FM (Fat Man) being placed on a trailer cradle in front of the Assembly Building August 1945

Page 12 of 16

A year before 'Lord of the Flies' was published, history's first atomic artillery shell was tested Nevada, USA, May 25, 1953

Page 16 of 16

Chopping Cotton - at work, preparing the cotton fields

The paddle boat 'Rita', Tennessee Valley Authority, 1937. Much of the commercial and

Appendix 5

Sample Booklet guidance for teachers

Research Project : ICT and English

Students will each need a copy of their questionnaire and a copy of the Sample Book. Teachers will need only the staff questionnaire. Instructions for completing the questionnaires are on the appropriate documents but I would be grateful if teaching staff could ensure that students are clear about what is required. In particular, please could you stress the following:

For questionnaire for students

The questionnaire will be scanned into computer by an optical mark reading machine, so please make sure students complete it in ink or biro (not pencil) and make each response go inside one box only.

The questionnaire is a lot easier to fill in than it might at first seem. There are no 'right' answers, so students just need to be as honest as they can.

The questionnaire is in three parts, each of which is different to the others and must be completed differently. Each part starts with instructions about what to do in that section but I would be very grateful if you could ensure that, for each part, students are clear about what they have to do by taking them through the instructions carefully.

- **Part 1**
  This is on the first page only. It is the trickiest of the three and will require care. The example at the top of the page should make it clear what students have to do, but the important thing is that for each of the twelve horizontal rows of boxes on the bottom half of the page, students are asked to put a *single* number (either a 1, 2, 3 or 4) in *each* box, *using each of these numbers once only in each row*. Please read through the instructions with them so that they are clear about this.

- **Part 2**
  This is a much more straightforward section. Students should read each statement carefully. If they think it is true of them, they should place a mark in the box next to that statement. The questionnaire says to use a cross, but a tick will do just as well. If they think a statement is not true of them, they should leave the box alongside it empty. So, mark all of those that are true for them – leave the rest blank.

Please turn over …

- **Part 3**
  For this section (only) students will need to use the **Sample Book**. For each page in the Sample Book there is a large boxed set of questions in the questionnaire itself. Each set of questions starts by telling students which page in the Sample Book to look at, so they need to be sure they are on the right page for each set. Please can you remind them about this during the session.

  For each question there are five possible answers – from 'very helpful' through to 'very unhelpful'. Students should place a tick in only one of these boxes for each question. If they are unsure, they should tick the box which is *nearest to* the way they think about that item.

  Please ask students to answer every question in every box.

IMPORTANT NOTE for when students are completing PART 3:

When students begin Part 3 above, please stress very heavily to them that when they are choosing which box to tick for each of the resources shown in the Sample Book for each of the questions, they should think about how easy they find it to learn when using that kind of resource. Please also read out the text in the following box:

> REMEMBER:
>
> Choosing **very HELPFUL** means you find it *very easy* to learn with the thing the question is talking about.
>
> Choosing **very UNHELPFUL** means you find it *very difficult* to learn with the thing the question is talking about.

Before collecting the questionnaires in, please ensure that students have put a score in each box for every question in Part 3 and have filled in their name and class at the top of the front sheet.

For the questionnaire for staff

Please would the class teacher write in the left hand column the name of each student in their class, one row to each student. There is a follow-on page for staff with larger classes. The column headings on the sheets are identical on each page. For each student, please place a tick in one (if essential, occasionally two) of the columns.

Thank you for your help with this.

Stewart Martin
University of Durham

Appendix 6

Test of knowledge and understanding

The test was a thirty-item paper-based assessment that was completed individually by participants in the normal class session immediately preceding the start of the intervention and before the study of the selected text began - and then again at the end of the intervention, roughly a half-term later.

Questions, with accepted factual answer content are shown below. Answers shown in italics indicate the kind of material or content required in a correct answer. All tests were first marked by the students' class teacher and then blind second-marked by an English teacher who was also involved in the study but was from a different school. Any differences in marks were subject to discussion and a mechanism was available for the use of a third 'arbitrator' marker but this was not required.

Questions are shown here by category - the actual test format randomised the order of all 30 questions.

QUESTIONS ABOUT KEY CHARACTERS

Question	*Answer(s)*
Name <u>three</u> of the main characters in Shakespeare's *Macbeth*	Banquo Duncan Lady Macbeth Macbeth Macduff Malcolm The Weird Sisters (or The Witches)
What happens to Macbeth at the end of the play and who else is with him at the time?	*Macbeth is killed by Macduff*
What does Macbeth see in his first vision?	A dagger
Tick which of these best describe Lady Macbeth's actions: Always supports her husband in public Cares about her husband's friends Has the interests of her country at heart Determined and clever Two-faced and scheming	 Yes No No Yes Yes
Which main character is murdered as they sleep?	Duncan
Who is the ghost?	Banquo
Give two reasons Banquo stays loyal to Macbeth	*He thinks he may personally benefit from events in the immediate future if Macbeth becomes King and additionally that if the witches' predictions come true then the crown may eventually pass to his family after Macbeth's reign is over.*
Which character sleep-walks?	Lady Macbeth
Who first suggests that Banquo should be murdered?	Lady Macbeth
Who is King at the and of the play?	Malcolm

QUESTIONS ABOUT IMPORTANT THEMES AND IMAGES

Question	*Answer(s)*
Name three important themes in the play *Macbeth*.	Ambition Chaos Clothes / Clothing Evil Light Order Sleep Time
Who talks a lot about 'equivocation' and why is this topic important in the play?	*The Porter.* *This is a major connection to the 'clothing' theme, which itself draws together all the references in the play to concealment, lying and the way outside appearances often hide the truth underneath.*
The play is mainly about how evil always triumphs in the end. Discuss.	*Incorrect.* *Events show that although it causes great destruction and pain, the forces of evil are always defeated by the forces of good in the end. In this respect the play has both a tragic and an optimistic conclusion.*
Describe how, in Shakespeare's time, many people saw the relationship between people and the world of nature. Illustrate your answer with some relevant examples from the play.	*Answer to include discussion of the Great Chain of Being (or similar name, such as the Ladder of Creation). Answer to also include recognition that God was seen to have given the world into the care of humans (idea of 'responsibility' to be identified in answer) and the relationship that existed between human actions and events in nature. Examples from the play to be provided.*
Choose any <u>two</u> main characters and explain for each one how they and their actions provide illustrations of how two different important themes or images operate in the play.	*Possible to use a wide range of material here.*
Does the play seek to show that being ambitious is a good thing? Explain your answer briefly.	No it does not. *Possible to use a wide range of material here, but illustrated reference to the character of Macbeth essential in the answer.*
Why does most of the play happen during daylight and sunshine?	It does not. *Very little of the play takes place in daylight. It is a gloomy, dark play for most of the time, because much of the action concerns dark and wicked deeds.*
Is it true that one message of the play is that we are each in control of own destiny? Give an example from the play to support your answer.	No. *One of the things that Macbeth learns is that some things - like him being King - are just never meant to be. This is why nothing he does can make this come out the way he wants, because it was believed at the time that there are some things that can never be allowed to happen. This idea is a key connection between several of the themes in the play.*
Using one example, explain what is meant by "Fair is foul, and foul is fair".	*Possible to use a wide range of material here.*
Pick <u>one</u> of the key themes or images found in the play. Write down why it is important and the ways in which it contributes to our understanding of events.	*Possible to use a wide range of material here.*

QUESTIONS ABOUT THE STRUCTURE & CULTURAL CONTEXT OF THE PLAY

Question	*Answer(s)*
In which century was Shakespeare's *Macbeth* written?	Choices given = 13th, 14th, 15th, 16th (correct), 17th, 18th, 19th, 20th
Which author is thought to have supplied the main literary source material for Shakespeare's *Macbeth*?	Raphael Holinshed, in his *Chronicles* of 1587.
In which country is the play set?	Scotland
How do the Elizabethan Age's ideas about astronomy and the structure of the universe relate to events that happen in *Macbeth*? Give an example of how the two can be seen to be connected.	*Possible to use a wide range of material here.*
Where was the King's place in the Ladder of Creation? What was this and how is this relevant in *Macbeth*?	*General explanation of Elizabethan World Order required, with underpinning idea of failure to observe this as equivalent to usurping God's will to be noted - this to be used to connect Elizabethan World Order to events in the play.*
Who was King of England and Scotland when *Macbeth* was first performed and why might this person have had a special interest in this play?	*Possible to use a wide range of material here, but a good answer must mention James I's special interest in witchcraft and his belief that he was descended from the historical Banquo. The parade of eight kings in one of Macbeth's visions might also be mentioned, as this is thought to have been intended as a deliberate compliment to James' lineage.*
What important political event happened very close to the time *Macbeth* was first performed and which key character from that event do we still remember today? How is this event relevant to the themes in the play?	The Gunpowder Plot of 1605 against King James I. Guy Fawkes. *Explanation of links to the play's themes and political/religious beliefs of the time.*
How are references to animals connected to different characters and themes in the play and how are these references used to emphasise the significance of the actions of the main characters?	*Possible to use a wide range of material here, but a good answer should contain references at least to the 'king's horses eating each other', to the use of bird imagery (e.g. the 'mousing owl that killed a falcon') and to the way the behaviour of these is linked to different characters at different times.*
Explain how the use of time (its passing and the times of day/night, etc.) is connected to the play's main themes and to the structure of the dramatic action.	*Possible to use a very wide range of material here, but a good answer should be able to give examples of the connection between the action in a particular scene, the time of day/night at that point, the location of the action and a particular theme. For example the opening of the play with the witches, the gloomy setting on a blasted heath, the themes of Ambition and Order or Evil, Light or Clothing and the use of this as a chilling opening setting.*
Explain why the 'Porter scene' appears where it does in the play and why Shakespeare used comedy at this point.	*Answer should explain the use of 'comic relief' to adjust the tension in the play, the use of the Porter as a Chorus to comment of the characters and action of the play and the placing of the scene to contrast with the action that goes before and after it.*

Appendix 7

Multimedia titles in the series:

Animal Farm	George Orwell
Great Expectations	Charles Dickens
Lord of the Flies	William Golding
Macbeth	William Shakespeare
Of Mice and Men	John Steinbeck
Roll of Thunder, Hear My Cry	Mildred D. Taylor
Romeo and Juliet	William Shakespeare
To Kill A Mockingbird	Harper Lee

Appendix 8

The multimedia *Macbeth* CDROM

NOTE:

The CDROM is available for loan from the university library.

Appendix 9

Software - design, operation and content

Below are examples of the main features of the *Macbeth* software, including illustrations of how it presents content to users, together with examples of the appearance of the various screens and menus it uses to structure content. Additional commentary is also provided which describes some of the multimedia features.

The topics and elements covered by the opening menu (Figure 1) include icons (animated opening and closing 'lockets' activated by a mouse-click) which lead to resources about: the plot ('Story'); the main dramatic characters ('Characters'); the main themes and images ('Themes'); the background to the literary work and the historical period in which it was written ('Background'); a section containing a range of questions about the literary work ('Quiz'); a section allowing for the location of words, ideas, themes, characters or other items within the original text or within an extensive commentary on the play ('Tracker'); access to the internet ('Internet'); and an option to exit the software ('Exit'). Opening the 'locket' for a topic reveals a number of buttons inside which are labelled with the various features or elements for that topic that are available. Each of the main elements is discussed and illustrated in the sections which follow.

Figure 1 Main opening screen of *Macbeth* showing the 'lockets' down either side of the large central viewing area. Lockets give access to the different areas of content.

The Story - Main Menu

Inside the 'Story' locket are two buttons - one labelled 'Tell' (for telling the story) and the other labelled 'Test' (for testing the student's recall of the story). As progress is made through the sequence of lockets, down the left hand side of the main screen and then down the right hand side, the intellectual challenge and complexity of the material and the depth to which the content of the play is examined tends to rise until the 'Internet" and 'Exit' lockets are reached.

This first 'locket' is therefore intended to give a simple introduction to the play and to familiarise students with the main events in the plot.

Via the 'Tell' button within this locket, the outline story (plot) of *Macbeth* is recounted through pictures on five consecutive screens (Figure 2). When the mouse is moved over the separate numbered pictures on each of these screens, this activates a spoken commentary for each one that provides a summary of the story for that section of the play and also suggests some important questions and ideas for the student to consider.

Figure 2 Main ('Tell') story elements in *Macbeth*.

1. The meeting between Macbeth, Banquo and the Witches on a desolate heath.
2. Lady Macbeth angrily tells Macbeth that they should murder King Duncan.
3. Alone at night, Macbeth waits for the signal to go and murder Duncan - he sees a ghostly dagger floating in front of him.
4. In the middle of the night, Macbeth murders King Duncan.
5. Macbeth is now King, but is afraid and does not trust anyone. He plots the murder of his friend Banquo.
6. Banquo is murdered but his son Fleance escapes.
7. Macbeth has a great feast to celebrate becoming King, but Banquo's ghost appears and frightens him. He vows to go and see the Witches to find out what his future will be.
8. The Witches show Macbeth three visions of the future that frighten him so much he decides he must carry on killing in order to remain safe as King.
9. The first vision was about Macduff, so Macbeth has everyone in Macduff's castle killed, but although all Macduff's family are murdered, Macduff himself is not there.
10. Lady Macbeth is having terrible dreams where she imagines she cannot clean her hands of blood stains.
11. Duncan's son, Malcolm, brings an army to defeat Macbeth at his castle in Dunsinane. The army conceals its true size with branches from trees. The second vision that the Witches showed Macbeth said he would never be defeated until Birnam Wood travelled to Dunsinane, so Macbeth thinks now he will lose the battle.
12. At the end of the play Macbeth feels betrayed by the Witches. He is killed by Macduff and Duncan' son Malcolm becomes the new King.

The 'Test' button inside the 'Story' locket leads to a screen depicting a library (Figure 3) with several books titled Act 1, Act 2, Act 3, Act 4 and Act 5. Each of these books, when clicked with the mouse, leads to screens which test the student's knowledge of events within that Act (Figure 4 shows an example from the book 'Act 4'). One additional book titled 'Get into Order' leads to screens where the student has to supply the correct Act for a list of events in the play (Figure 5).

Figure 3 The main 'Test' screen for the story elements in *Macbeth*.

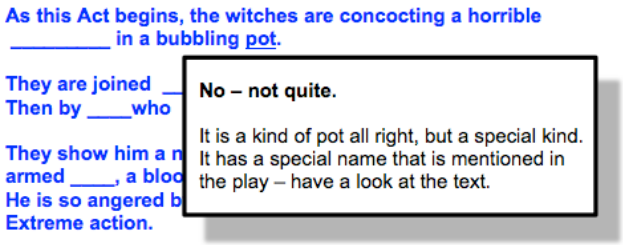


Figure 4 A 'Test' element from the 'Act 4" book in Figure 3 showing a 'cloze' (fill-in-the-blank) format, with interactive feedback for the incorrect answer "pot".

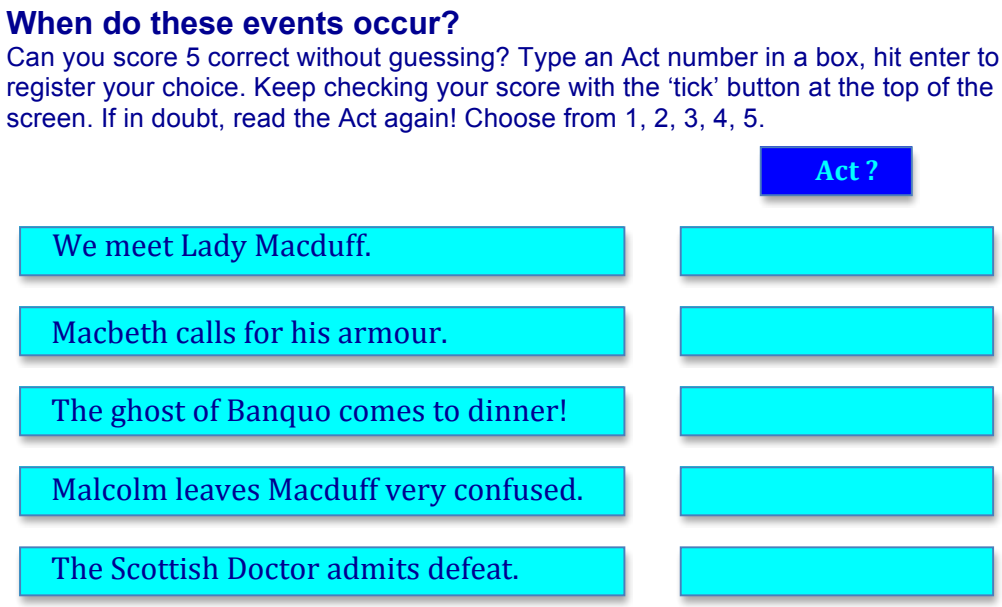


Figure 5 Sample question format from the 'Get into Order' book .

As with all the 'Test' sections throughout the software, the question formats incorporate feedback for correct, partially correct and incorrect answers. Feedback to question answers is designed to promote further learning by offering affirmation, reinforcement for correct answers, additional learning, suggestions, prompts and hints or a factual answer, and it often also directs the learner to another area of the resource for additional help or information and to specific locations within the physical text being studied.

Each multimedia package therefore contains a range of resources for exploring and understanding content and for the teaching and testing of many elements within the literary work, including its story (plot), language, characters, themes and imagery, its dramatic structure and its cultural context.

Characters – Main Menu

The dramatic characters in *Macbeth* are varied and complex and perform sometimes very different functions within the structure of the play. The second 'locket' down the left hand side of the main screen deals with the Characters in the play. The 'Teach' and 'Test' options offered within the 'Characters' locket on the Main Menu screen (Figure 1) lead to content designed to improve the learner's understanding and memory of the most important things about the actions, speeches and significance of the dramatic characters in the play, including the 'minor' characters.

The panel below the main working area of the screen always shows the user which section of each 'locket' content they are currently viewing. For example, Figure 6 shows the different messages that are displayed when the 'Teach' and 'Test' options are selected after opening the 'Characters' locket.

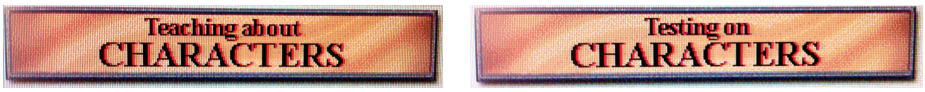


Figure 6 Notifications to the user: 'Teaching' and 'Testing' modes

Figure 7 Characters: Interactive menu functionality

Moving the mouse over the main working area display for 'Characters' (Figure 7) reveals a 'scroll' showing the name of each character(s) as the relevant part of the picture is passed over and clicking each of these interactive parts of the picture provides access to information about the relevant dramatic character(s) in *Macbeth*. Changes in the background colour are made to the 'Teach' and 'Test' main screens to distinguish them, although as with other menus offering 'Teach' and 'Test' alternatives, this information is also shown below the main working area of the screen (Figure 6).

The examples given below (Figures 3-6) illustrate representative content material for a small selection of the characters in the play and that are dealt with in the software. A variety of different 'Test' question formats is used and only a sample is shown below, to illustrate this variety and the differing level of challenge that is presented using these formats.

Note that often the 'Teaching' and other sections of the software include spoken voice-over information to supplement the text or images shown on the screen and therefore users were advised, throughout the use of the software, to have the computer's sound turned up so as to hear these.

Teaching mode	Testing mode
The witches represent disorder, darkness and chaos. They are images of the evil in the world which tempts people to their doom.	**How well do you know the character? Click in the blue box and type in the word (or words) you think is (or are) the right answer.** They torment one character who we never actually meet – who is it? Name one of their familiar spirits. What object do they use to make their charm? Complete the line: "Fair is foul, ……." They tell Macbeth he will be Thane of …. ?

Figure 8 Teaching and Testing content for the characters Witches.

As with every instance of 'Test' questions in the software, typing an answer provides context sensitive feedback which is also often designed to aid further learning, either by giving more information or providing hints and links back into the text of the play so as to develop deeper understanding. In the example above (Figure 8), typing the correct answer "Cawdor" for the last question produces the response:

> **Very good.**
>
> This is one of the things that convinces Macbeth that they may be telling him the truth about the other things that they say are going to happen. What Macbeth doesn't at first realise is that they don't always tell him all of the truth, just parts of it – and even then, what they say is very ambiguous.

… whereas typing an incorrect answer for the first question produces the response:

> **No.**
>
> This isn't too complicated. A one-word answer will do. Check near the start of the play for information on this, or search the text for "Aleppo" for the exact reference. (Hint: 'Aleppo' isn't the answer, but it will take you to the line in the play that contains the answer.)

Note that the suggestion here about 'searching the text' would normally be an onerous task that pupils would be unlikely or unable to complete, but this can be accomplished very easily using the features provided via the 'Tracker' locket on the Main Menu screen of the software.

Teaching mode	Testing mode	
Macbeth's a noble and brave warrior at the start of the play. He is Thane of Glamis and highly respected by everyone. When he meets the witches, he's fascinated by their prophecies. What they say seems to start coming true, and Macbeth's thoughts turn to murder and evil.	**Which THREE explain Macbeth's feelings of guilt?**	
	a) He owes the King loyalty.	**a, b and d**
	b) He'll let his wife down if he doesn't act.	**c, d and e**
	c) Duncan treated him well.	**b, c and e**
	d) The King was a guest in his home.	
	e) Malcolm was to have been the next King.	**a, c and d**
	Click a box to indicate your choice.	

Figure 9 Teaching and Testing content for the character Macbeth.

The 'multiple-option' format shown in Figure 9 is an example of a more demanding question. Selecting the first (incorrect) option produces:

> **Wrong.**
>
> What does the question ask you to look for? Do **a**, **b** and **d** all deal with guilt, or is one of them more about Macbeth being accused of cowardice?

Typically, the correct (last) option produces quite a full explanation of why this is the best answer:

> **Good.**
>
> Macbeth does owe the King his loyalty – he's a soldier in his army and one of his subjects. Duncan has also treated Macbeth very well – he has made him Thane of Cawdor and praised him in front of his noblemen. And when Duncan is a guest in Macbeth's home, he should be able to rely on his host to protect him from harm, instead of which Macbeth murders him with his own hands.

Throughout the software package, the purpose of this kind and level of feedback is to ensure that even when pupils select answers wholly or partly by using guesswork, the software attempts to help them understand more fully why the chosen answer is correct.

Teaching mode

Banquo's goodness emphasises Macbeth's shortage of noble qualities. Macbeth is concerned about what the witches promised Banquo, so he plots to have him and his son Fleance murdered. But Fleance manages to escape.

Testing mode

a) He covers up for Macbeth after the murder of the King. — True / False

b) His wife and child are murdered by Macbeth's hired killers. — True / False

c) He runs away from the men who are sent to murder him. — True / False

d) He thinks Macbeth murdered King Duncan in order to get the crown. — True / False

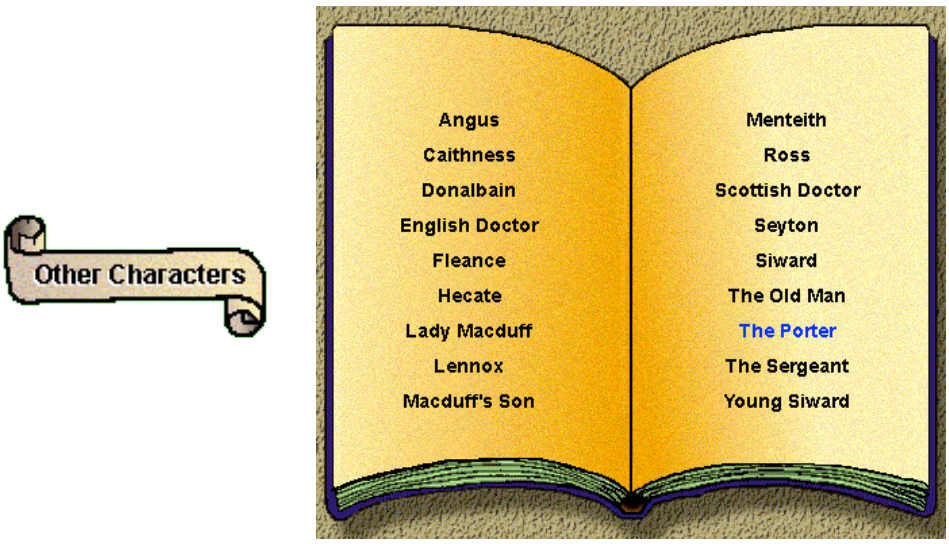
Click a True/False 'light' to indicate your choice.

Figure 10 Teaching and Testing content for the character Banquo.

True / False-type questions (Figure 10) also produce explanations when responses are made – again the intention is to produce learning at all times. For example, selecting 'False' in the second 'Testing' item in Figure 10 produces a response designed to clear up the frequent confusion in students' minds between which families that are – and are not – murdered by Macbeth:

> **Yes – this is the correct response.**
>
> It's Macduff whose wife and child are murdered by Macbeth's men. Although we know Banquo has a son, there is no reference in the play to him having a wife.

The 'Other Characters' menu (Figure 11) covers what were usually termed 'minor' characters, many of whom perform important dramatic or structural functions within the play and are not in that sense minor at all. It is therefore important for students studying *Macbeth* in preparation for public examination to understand the role of these other characters and what they contribute to the dramatic action. The example question format shown in Figure 11 focuses on the character of the Porter.



A minor character who appears when there is knocking at the gate of Macbeth's castle late at night after the murder of King Duncan.

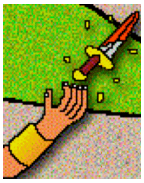
As a traditional figure in plays of the time, the Porter would be recognised by the audience as the Gatekeeper to Hell. Macbeth's castle is therefore the entrance to Hell, emphasising that by murdering the King, Macbeth has just lost his soul.

1. **As a contrast to the murder of Duncan.**
2. **As the gatekeeper to Hell.**
3. **As a chorus, commenting on the action of the play.**

Figure 11 Teaching and Testing content for the other ('minor') characters: 'Teaching' illustration for the character of the Porter, with voice-over spoken commentary .

Figure 12 Themes: Interactive menu functionality - Key themes operating within *Macbeth*

Interactive icons on the graphic user interface provide access to 'Teach' and 'Test' information on and background to the main themes and images in the play (Figure 12). These give examples of how images and themes are expressed in the text, what resonance their use may have had for audiences at the time and how they create or emphasis dramatic effect. The 'Test' formats provide questions, with context sensitive feedback, to reinforce learning; two examples are given in Figure 13.



Ambition

Teaching mode

Macbeth and Lady Macbeth are ambitious, but she is single minded about it whilst he at first has scruples about doing wrong. Macbeth's reservations are overcome with the help of the Witches and Lady Macbeth and he murders the king to achieve his ambition. But he gets no satisfaction from this and eventually loses everything.

Testing mode

a) Macbeth's downfall is not his ambition but something else. — True / False

b) When Macbeth achieves his ambition he is not made happy by it. — True / False

c) The play shows that being ambitious is dangerous, foolish and wrong. — True / False

Order

Teaching mode

Macbeth's main crime is the disruption of Order. The theme and imagery of order includes references to order in Nature and in The State. These two are linked because the King (appointed it was thought by God) is at the head of the whole of humanity, where every person knows their place. Macbeth upsets every kind of order – political, social, family and even 'mental' order and stability.

Testing mode

a) King Edward and Duncan are both used as symbols of order. → True / False

b) By the end of the story, Order is restored to the world. → True / False

c) Macbeth's greatest crime is to upset the natural order of the world. → True / False

Figure 13 Exemplar content for 'Ambition' and 'Order'

Background to the Text and Age

Clicking (opening) the 'Background' locket on the Main Menu screen (Figure 1) reveals two options: 'Text' and 'Age'. Figure 14 shows the menu screen which appears if 'Text' is selected; Figure 16 if 'Age' is selected.

Figure 14 Background to the text: Interactive menu

Interactive icons on the 'Background to the Text' graphic user interface (Figure 14) provide access to information on and background to the Text for: biographical information about Shakespeare; a chronology of the text; where some of the source material for *Macbeth* is thought to originate; the 'geography' of locations mentioned in the play; some 'recipes' of the time; historical 'photographic' views (sketches) of Stratford-Upon-Avon; and a chart of family relationships between the characters in the play.

These references and resources are designed to help students gain a sometimes amusing insight into the background of the play's action and setting or to gain a deep insight into the dramatic origins of the story and drama; three examples are given in Figure 15 – the full text of the Holinshed source for the drama; some amusing cookery; and an interactive map of Scotland which contrasts the location of the action in the play with historical information about the same places.

The text of Holinshed

This section provides a fully searchable copy of the text for the Holinshed original together with embedded commentary and explanation to link it to Shakespeare's version.

We now return to Macbeth's history, at the point where he meets the witches in Act 1 Scenes 3:

Shortlie after happened a strange and vncouth woonder, which afterward was the cause of much trouble in the realme of Scotland, as ye shall after heare. It fortuned as Makbeth and Banquho iouirnied towards Fores, where the king then laie, they went sporting by the waie togither without other companie, saue onelie themselues, passing thorough the woods and fields, when suddenlie in the middest of a laund, there met them three women in strange and wild apparell, resembling creatures of elder world, whome when they attentiuelie beheld, woondering much at the sight, the first of them spake and said: "All haile, Makbeth, thane of Glamis!" (for he had latelie entered into that dignitie and office by the death of his father Sinell). The second of them said: "Haile, Makbeth, thane of Cawder!" But the third said: "All haile, Makbeth, that hereafter shalt be king of Scotland!"

Recipes

This section contains both a light hearted and serious depiction of the cooking of the day.

Witches Broomstick Broth

Poisoned entrails
Slimy toad
Slice of snake
Newt's eye
Frog's toe
Bat's fur
Dog's tongue
Snakes' tongue & poison
Lizard's leg
Wing of baby owl

(Source: Macbeth, Act 4 Scene 1)

Macbeth's banquet menu

A typical King's banquet of the day might include:

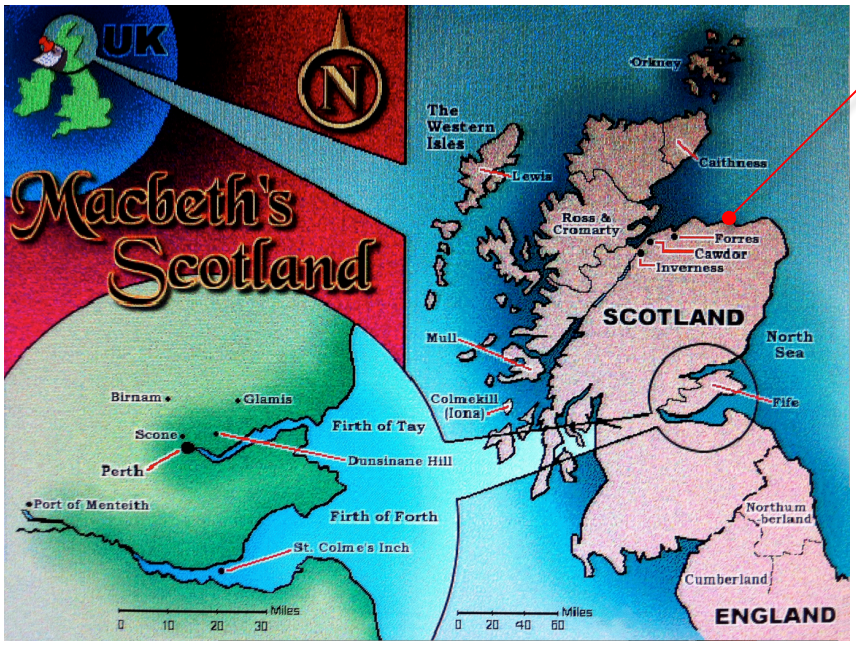
20 sheep
5 cows
10 deer
20 pigs
130 chickens
100 pigeons
35 swans
800 larks

and take 6 or 7 hours to eat!

(Source: Contemporary diary of the time of King Henry VIII)

Macbeth's Scotland

This interactive map shows the location of events in the play alongside their historical significance and relevance. One location 'popup' example for 'Forres' is shown.



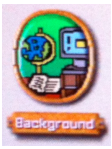
FORRES
In the play
At the start of the play Banquo and Macbeth are travelling towards Forres. Banquo asks how far it is.

In history
Forres castle was a royal hunting seat used frequently by Scottish Kings from William the Lion onwards and, traditionally, by Duncan and Macbeth. Just beyond the Eastern entrance to the town stands Sweno's Stone, a carved sandstone monolith 7m high with the figures of men on one side and on the other a cross with complex runic decorations. Nearby stands the Witches' Stone, the scene of early witch burnings.

Figure 15 Exemplar content for 'Source', 'Recipes' and 'Macbeth's Scotland'.

The 'Background to the Age' screen (Figure 16) provides a wide range of information about the Elizabethan Age and explains how the content covered by links from this menu is important in understanding much of the context, settings and references found in the dramatic works of Shakespeare and other writers of the time.

Interactive icons on the graphic user interface for 'Background to the Age' provide access to information on and background to the Elizabethan Age and also, where relevant, use examples to discuss where some of the references to each topic are to be found in the works of Shakespeare, what resonance they would probably have had for audiences at the time and the ways in which they were used to create or emphasis dramatic effect. A summary of what content each icon led to is given in Figure 16 above, and below are provided descriptions of the content (on the left-hand side under each icon) and brief extracts from the content itself (on the right, under each icon).




Mythology and Bestiary


Elizabethan sports


Astronomy and the Elizabethan Universe


The nature of human kind


Life in Elizabethan England


Alchemy


Magic and Superstition


Medicine


Education


The Four Humours


Chronology of the Age


Music

Religious beliefs

The Ladder of Creation (Great Chain of Being)


Travel and voyages of discovery

Figure 16 Background to the Age: Interactive menu functionality - Key aspects of the Elizabethan Age referred to in the writings of Shakespeare

Mythology and the Elizabethan Bestiary

References to real or fabulous animals are common in the works of Shakespeare. Animals were thought to have particular qualities that were intended by God to have meaning and 'lessons' for human kind.

Cats were the companions of witches. In Romeo & Juliet we find the adage that cats have nine lives. People used to hang up cats in leather bags for amusement and shoot at them with crossbows. Elizabethan ideas of what was fun were sometimes rather blunt. Amazingly, the cats often survived. Maybe this is where the adage comes from.

Elizabethan sports

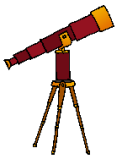
Sports in Elizabethan times, such as archery, fencing, horse riding, hunting, the Quintain were often extensions of military activity

Longbowmen from the 15-16th Century

The state of English archery at this time was poor, and the Government worried continuously about the country's general military preparedness. It even went so far

and therefore taken extremely seriously.

as to ban games and sports which did not, in its opinion, promote useful war-skills. Few people seem to have taken much notice, though ...



Astronomy and the Elizabethan Universe

Key astronomical ideas and figures relevant to understanding the Age and the works of Shakespeare covered include: The Middle Ages, Copernicus, Kepler, The Structure of The Universe, The Crystal Spheres, the Elements, Astrology, Angels, the Zodiac.

In Twelfth Night we find the old idea that different parts of the body were in some way linked to different parts of the heavens:

SIR TOBY BELCH: I did think by the excellent constitution of thy leg it was formed under the star of a galliard.

SIR ANDREW AGUECHEEK: Ay, tis strong, and it does indifferently well in a flame-coloured stock. Shall we set about some revels?

SIR TOBY: What shall we do else? Were we not born under Taurus?

SIR ANDREW: Taurus: thats sides and heart.

SIR TOBY: No, sir, it is legs and thighs.

This is a joke, as Shakespeare almost certainly knew that Taurus was in fact associated with the neck and throat. Sir Toby meant that their revels (celebrating, or enjoyment) should be dancing, with legs and thighs, but the neck and throat suggest drinking, what was therefore correct in a different way.

The nature of human kind

Elizabethan ideas about the relationship between human society, individuals, God and the nature of the universe are very frequent in Shakespeare, where they are often used to draw parallels between the ordered world of Nature and the actions of people.

It was a common notion that the order of the state duplicated the order in the universe. This is the central theme of several of Shakespeare's plays, notably Macbeth and King Lear. Frequent comparisons were made between the King, ruler of the State and the sun, ruler of the Heavens. Similarly, disorder in the heavens paralleled civil disorder in the state. Some of the best known episodes in Shakespeare's plays deal with this point - for example the descriptions of natural chaos that follow the deaths of Caesar in Julius Caesar, or Duncan in Macbeth.

Life in Elizabethan England

Topics covered in this section of the software include discussions of: government, marriage, children, living in towns and cities, crime, money lending, clothing and social position, the army and navy, the theatre and actors, the baiting of animals.

There was a clear social order in England at this time in history, with an insistence on this being observed by everyone. The relative importance of different people was shown by rules of what was called 'degree, priority and place'.

At the top of the social order was the King or Queen, after which came the nobility and then the peasants. In Queen Elizabeth's time there were only about 60 members of the nobility, and they held tremendous power.

Alchemy

This section of the resource explains the place of Alchemy in Elizabethan belief and in Shakespeare - topics covered

What the Elizabethans did have, instead of science, was Alchemy. The main assumption in Alchemy is that everything is made of one basic indestructible substance called Primary Matter, which comes in four different forms. These different forms have different characteristics or qualities of Primary Matter and are:

include the Four Elements, Medieval 'Science', and Metals.

Hot, Cold, Dry, Moist. ...

... So anything which changed over time, or was temporary or which decayed, could not be perfect. This included a wide range of different objects, substances or phenomena. Humankind was not perfect, for example. Neither was lightning, or the early morning dew.

Magic and Superstition

Magic and superstitions held powerful sway over the way people thought in Shakespeare's day and were thought to affect a number of things covered in this section, such as the human body, plants, ghosts, fairies, elves, witchcraft and devils.

Ghosts were widely believed in, just as much by the ignorant commoner as the educated scholar. Ghosts were thought to come after midnight but had to leave before cock-crow. People who knew Latin, and the right spells, could summon ghosts - but it was thought to be very dangerous to summon and question them. Ghosts wandered the earth because of some 'score' which had to be settled, or to issue warnings, or to watch over hidden treasure.

Medicine

Illness and the role of medicine were understood differently in Shakespeare's day than is the case now, and this section explains how they relate to the coverage of these topics in his works.

Probably as much as half the Elizabethan population lived at subsistence level, and all were liable to sudden pain, incurable sickness and death. Writers like Shakespeare were no exception, and they often led lives of poverty and squalor.

… Mental disease is dealt with more skilfully in Shakespeare's plays than any other kind of illness, with large parts of Macbeth, Twelfth Night and Hamlet especially concentrating on it. Shakespeare also recognised the value of ordinary sleep:

… that knits up the ravell'd sleave
of care, the death of each day's life,
sore labour's bath, balm of hurt
minds, great nature's second course,
chief nourisher in life's feast.
(Macbeth; Act 2, Scene 2)

Education

Learning, teaching and learning are common themes in Shakespeare and in this section the software explains how Elizabethan society viewed the importance of these.

Teaching methods traditionally involved corporal punishment for mistakes and obedience was also the keystone of family life. Chastise your child and imprint discipline in his heart while he is young and (impressionable), and you shall bow him to what instruction you will, was common advice. This attitude pervaded all of society and having good manners might easily mean the difference between succeeding or failing to get a job.

The Four Humours

These screens give information about how an understanding of the Elizabethan's philosophy of the Four Humours can help in the understanding of many passages and references in Shakespeare

There are a great number of references the 'elements', or 'humours' in Shakespeare's works, where they serve to link the doings of men with the workings of the universe. The four elements were also basic to the study of Alchemy. Gold was the king of metals and a permanent, perfect mixture of the elements. The same mixture in man produced perfect health. Gold was therefore unique on earth. Nothing known to the Elizabethans could damage, dissolve or destroy gold in any way.

Chronology of the Age

These screens use a timeline to locate important events, people and discoveries of the time in relation to each other and the works of Shakespeare.

1513 Machiavelli writes 'The Prince'.
Balboa discovers the Pacific South Sea.
1517 Martin Luther nails up his Ninety-five theses.
Beginning of the Reformation.
1518 Magellan begins first circumnavigation of the world.
Death of Leonardo da Vinci.
1521 Mexico conquered by Hernando Cortes.
1532 Henry VIII divorces Catherine of Aragon.
Peru conquered by Francisco Pizarro.

Music

These screens have sections discussing Music, Instruments, Dancing and references to these in Shakespeare's work as well as commentary on the implications of these references and why music, dancing and instruments are mentioned so often.

There was constant traffic between the earthy 'folk' music and the music of educated people. This was made easier than it might otherwise have been because the Elizabethans were very tolerant of obscenity, which they saw as more natural than many people do today. However, they cracked down on ...

Religious beliefs

The importance of religion and religious belief in Elizabethan times is explained in the context of history so that the many references to this in Shakespeare might be better understood.

The English Reformation shifted emphasis away from people sitting in church listening to a Latin mass to them reading the Bible for themselves. It was thought that this was more important for a person's salvation. This had a big effect on the spread of literacy ... the new Protestantism seemed to put the key to salvation in the hands of the individual ...

The Ladder of Creation (the Great Chain of Being)

The Elizabethan's intense interest in the nature of mankind and, through God, its relationship to the universe is explained and related to Shakespeare's writings.

Through the themes and images which are woven into his works … Shakespeare … explored man's relationships with heaven, with hell, with beasts and the universe at large.

Macbeth's sin is not only against human decency, but against the whole chain of being, and this is often stressed by the imagery of animals and beasts.

Travel and voyages of discovery

This gives details about travel in Elizabethan times - over land, sea and within other countries. There were many significant journeys of discovery and the main ones during the period are described and their relevance for understanding Shakespeare are explained.

Shakespeare was a European writer and his plots, themes and scenes show this. For the events and characters of old time plays, he moved his settings to Athens and Rome …

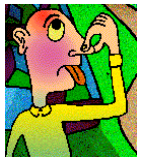
Shakespeare was not a geographer, nor should we imagine that his audience would be aware of what the modern traveller would call errors, such as in 'The Two Gentlemen of Verona', where Verona is described as a tidal port. Shakespeare's audience were far from ignorant, but most of them were by modern standards very untraveled.

Quiz – Test Your Wits

The 'Test Your Wits' material in the Quiz Menu (Figure 17) covers the material found throughout the software and focuses on the ability of students to recall important facts, ideas and quotations that they will need when answering examination questions about *Macbeth*. Although the tone of much of the content is light hearted, the intention is serious and although answers and more information can be found within the rest of the software (and answers are provided to Quiz questions via a 'Dunce's' cap - Figure 18) the questions nonetheless include some difficult material that will challenge even quite able students.

The 'Teach' and 'Test' options offered within the 'Characters' locket on the Main Menu screen (Figure 1) lead to content designed to improve the learner's understanding and memory of the most important things about the actions, speeches and significance of the dramatic characters in the play, including the 'minor' characters.

Figure 17 Quiz Menu (Test Your Wits)



Disgusting stuff

Who said that?

Echoes

Name that place

Whose is this?

Missing people & places

Finish me off!

Order! Order!

Who did this?

Dunce's cap

Figure 18 Background to the Age: Interactive menu functionality - Key aspects of the Elizabethan Age referred to in the writings of Shakespeare

Interactive icons on the graphic user interface for 'Background to the Age' provide access to information on and background to the Elizabethan Age and also, where relevant, use examples to discuss where some of the references to each topic are to be found in the works of Shakespeare, what resonance they would probably have had for audiences at the time and the ways in which they were used to create or emphasis dramatic effect. A summary of what content each icon led to is given in Figure 18 above, and below descriptions of the content are provided (on the left-hand side under each icon) and brief extracts from the content itself for the first.

Disgusting stuff

These items test the student's recall of some of the (more revolting) events in the play.

As always, answers prompt feedback – here shown for an incorrect response to item two …

No.

It's a character that acts rather like a Chorus (a commentator) on the action of the play.

What this character says also refers to the contemporary events to do with the Gunpowder Plot, which was a hot topic of conversation at the time the play was first performed.

Who wants their blood to be made thick with evil? →

Who talks about urine? →

Who's left in a ditch with twenty gashes on his head? →

Whose nose is put in the witches cauldron? →

Who'd rather dash a baby's brains out than break their word? →

Who owns a pilot's thumb? →

Who chops people in half? →

Name that place
Asks students to identify important places or locations where events happen, such as the name of the wood that moves (Birnam), or the location of the first appearance of the witches (blasted heath).

Finish me off!
Asks student to supply the missing words from important quotations such as: "A little _____ clears us of this deed" (water).

Who said that?
Challenges students to identify the speaker of important quotations from the text, such as "What he hath lost, noble Macbeth hath won" (Duncan).

Whose is this?
Tests if students can correctly identify the owner of various items, such as "a giant's robe" (Macbeth) or a lighted candle (Lady Macbeth).

Order! Order!
Requires student to correctly locate the Act for key events such as the death of Lady Macbeth (Act 5) or Macbeth's vision of daggers (Act 2).

Echoes
Provides examples of structural or thematic 'echoes' in the play and asks students to identify the missing element. For example the correct answer for "Macbeth has none; tries to kill them; they will steal his future" is 'Macbeth', and for "The thane of which place betrays Duncan twice" is 'Cawdor'.

Missing people and places
Tests whether students can correctly identify people and place – such as "Name Macbeth's father" (Sinel).

Who did this?
Asks students to identify a character from something that they did, such as "Was from his mother's womb untimly ripped" (Macduff), or "Wants to be 'unsexed'" (Lady Macbeth).

Tracker

The 'Tracker' locket allows students to explore the Text or an extensive range of commentary on the text. Both the text and the commentary sections are arranged sequentially from the start to the end of the play, with detailed Act and Scene notations throughout. Dynamic links between these two sections provide immediate connections between a particular part of the commentary and the text in the play to which this relates. A student studying a particular

section of commentary on the play can, therefore, immediately switch at any time to seeing the Act, Scene and text to which this relates. In the 'Text' section the text itself is colour coded throughout to show Act and Scene notation together with stage directions (in red), the text of the play itself (in black) and the many sections of the text which use archaic or confusing language or invoke references that are likely to be particularly confusing a young person today (in purple). When the computer mouse is moved over each of these latter (purple) pieces of text a spoken commentary gives a modern translation or explanation of the reference that fits exactly the sense of the meaning at that point (see Figure 19). Figure 20 provides an example of the information given by the commentary for the first line of the linked text (in purple) in Figure 19.

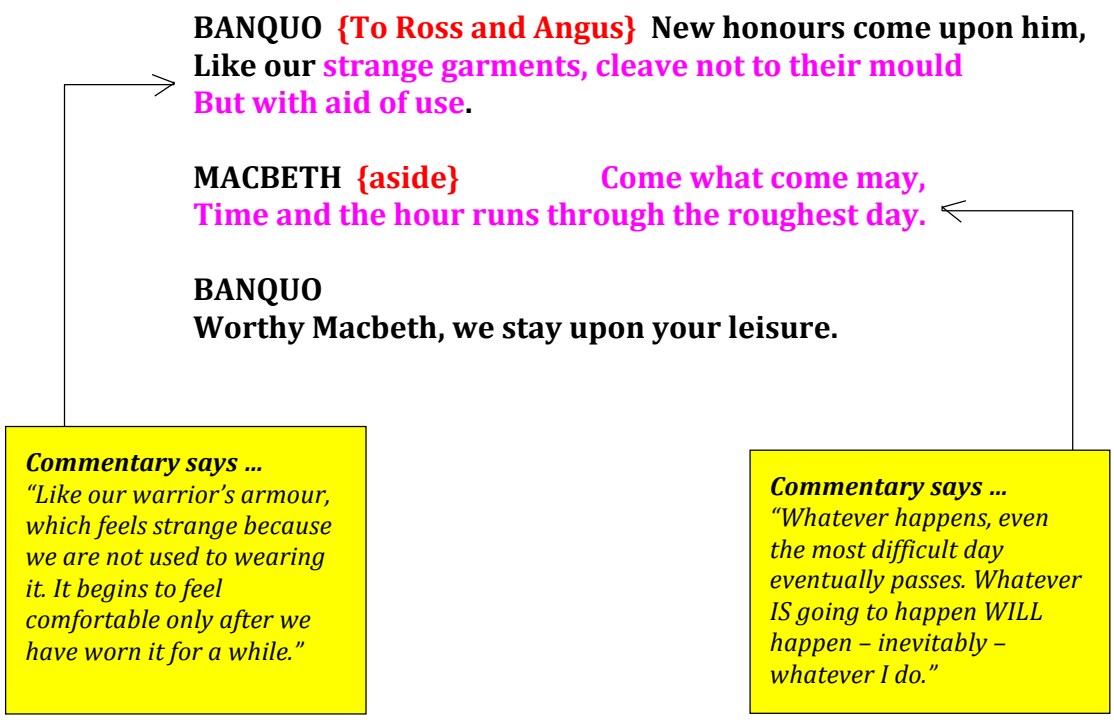


Figure 19 Tracker: Example layout for 'The Text' from Act 1 Scene 3 showing colour coding and the text for the spoken translation that is played when the computer mouse is placed over the purple text.

Act 1, scene 3, line 145
'Like our strange garments, cleave not to their mould ...'

Commentary says ...

It takes time to feel comfortable in new clothes, suggests Banquo. Consider the effect that the 'borrowed robes' have on Macbeth.

Figure 20 Tracker: Example of colour coding and the spoken translation that is played when the computer mouse is placed over the purple text.

Internet and Exit

Finally, the 'Internet' and 'Exit' lockets provide connection to the internet and close down the software, respectively. Earlier versions of the Windows software permitted internet access which, when cancelled, returned the user to the software package but occasionally using this feature with contemporary versions of Windows - whilst providing internet access as requested – now sometimes also causes the software to close.

Appendix 10a

Ethics form

FORM EC2

UNIVERSITY OF DURHAM

ETHICS ADVISORY COMMITTEE

APPLICATION FORM FOR RESEARCH ETHICS APPROVAL OF WORK WITH HUMAN VOLUNTEERS

Introduction:
All University work with human volunteers must be assessed for ethics approval, whether it is in teaching, undergraduate or taught postgraduate project work or research. Ethics approval must be sought from either the University Ethics Advisory Committee or an NHS Local or Regional Ethics Committee. NHS Committees must be used where patients, tissue sampling or invasive procedures are involved. Certain work with babies and children must also be referred to an NHS Committee. Even if approval is given by an NHS Committee, the researcher or academic supervisor must inform the University Ethics Advisory Committee of the work.

Please use this form for research work and project work. Teaching work may be submitted with a brief description. Both need Board of Studies' approval. You should also enclose a copy of the consent form you will be asking volunteers to sign and the information sheet you will give to volunteers; an example consent form is included at the end of this form, and this should be followed as closely as possible. You are recommended to provide volunteers with a separate information sheet, rather than combining the information sheet and consent form into one, in order that volunteers can take the information sheet away with them.

Please send the form to the Secretary of the Ethics Advisory Committee (Chris Millward, Research and Economic Development Support Services, Old Shire Hall; telephone 7600; email: Chris.Millward@durham.ac.uk). Returned applications must be either typed or word-processed.

SECTION A INVESTIGATOR:

1. NAME, QUALIFICATIONS, POST HELD: Stewart Martin, B.Ed., M.Ed., lecturer

   RESEARCH SUPERVISOR OR ACADEMIC-IN-CHARGE (TEACHING) Prof. Barry Cooper

   UNIVERSITY DEPARTMENT: Education

2. LIST ALL CO-WORKERS AND THEIR EMPLOYER (AND DEPARTMENT) AND RESEARCH EXPERIENCE: None

SECTION B DESCRIPTION OF WORK

5. TITLE OF PROJECT: Effective Learning with ICT in English Literature

6. ABSTRACT

The use of ICT to improve teaching and learning is an area of continuing interest for the governments and educators of many nations. Previous research projects have investigated the educational impact of ICT and have shown that improvements in skills and other learning is possible, although this has often been in contexts which have been difficult to relate to existing practices and priorities in educational institutions. In subjects such as English Literature educators often wish to develop higher order abilities (reflective criticism, literary appreciation, sensitivity to nuances of meaning in language, etc.) rather than mechanical, 'closed' or task oriented skills in their students. Much currently available software is perceived by educators in these subject areas to be unhelpful or irrelevant because it fails to meet 'real' educational needs or produce relevant significant learning. This study will use a specially developed suite of multimedia programs designed to work with teachers and students at KS3 and KS4 to promote such relevant and significant learning. Learning outcomes will be evaluated against teachers' and external assessment criteria (public examination

requirements) as well as those of students and used to improve the software's ability to address these effectively. The implications of this study for the more effective classroom use of ICT (including teacher training) will also be explored. The effectiveness of the intervention will also be evaluated from a theoretical standpoint using Kolb's Learning Styles Inventory.

7. OBJECTIVE: *hypothesis to be tested*
The appropriate use of ICT can produce significant effective learning with regards to the desired educational outcomes of teachers, external examination requirements at KS3 and/or KS4 and students.

8. DESIGN OF STUDY, in brief
Selected groups of students will use the software as part of normal course study in a number of different schools, with the support and collaboration of their teachers. Outcomes (see above) will be compared with control groups within each institution who do not use ICT to develop learning in this subject area at all.

9. SUMMARY OF RESEARCH PROTOCOL
Use of questionnaires for Learning Styles and to test subject knowledge and understanding will accompany the use of the multimedia software. Teachers will be involved in the design of the instrument for testing subject knowledge.

10. BENEFIT
Please state what benefit to society or individuals should arise from the work.
Improved educational outcomes for students and teachers in English Literature; increased confidence and skill of teachers in the use of ICT; work towards the development of a practice-based understanding of what constitutes the educationally effective use of ICT in the particular subject area.

11. FUNDING
Please state the source of funding for the work. None.

12. SUBJECTS

(a)	How many?	Selection (e.g. age, sex)?	Pregnancy (excluded?)
	Undetermined	Male and female	Excluded
(b)	Status of subjects (e.g. students, colleagues)		students
(c)	Is there any link with the investigator (supervisor, tutor, etc.)?		No

13. CONTROLS (needed?). If so, how many, who are they, how recruited/selected?
Controls needed, recruited/selected same as subjects.

14. HEALTHY VOLUNTEERS: Who are they? (How used? How recruited?)
Recruited after discussion with Head teachers and teachers is current Partnership Schools and used to work with the project resources as part of their normal lessons.

15. ARE SUBSTANCES TO BE GIVEN TO SUBJECTS? ~~YES~~ / NO
If YES - complete Appendix A

16. ARE SAMPLES TO BE TAKEN FROM SUBJECTS? ~~YES~~ / NO
If YES - complete Appendix A

17. ARE OTHER PROCEDURES TO BE APPLIED? YES / ~~NO~~
If YES - complete Appendix A, including a copy of your questionnaire. **(To follow)**

18. RISKS AND HAZARD

What risks to subjects are present?	PROBABILITY	SERIOUSNESS
None		

State precautions to minimise each risk
N/A

19. DISCOMFORT OR DANGER
What discomfort, danger or interference with normal activities will be suffered by the subject? None
State precautions to minimise them: N/A

20. STATISTICS
Has statistical advice been sought on study design?

YES ✓ NO NOT APPLICABLE

If YES, from whom? If NO, give reasons.
Advice will be sought from research supervisor.

21. CONSENT

Please answer the following points in the space below:

(a)	Who will explain the investigation to the subject?	Myself, in conjunction with the class teacher and/or Head of Department
(b)	Will written explanation be given to the subject	No
(c)	Will written consent be obtained? If not, why?	Yes, from the school, acting in loco parentis.
(d)	How and where will consent be recorded?	Formal letter of agreement to participate

Please attach copies of any subject explanation leaflets and written consent form.
Copy of initial letter of explanation attached, along with sample response from institution.

22. CONFIDENTIALITY

(a) Indicate what steps will be taken to safeguard the confidentiality of subject's records. If the data is to be computerised, it will be necessary to ensure compliance with the requirements of the Data Protection Act.

Subjects and institutions will be allocated anonymous numbers with the translation codes known only to myself. No references will be made in published research which permit individual students, teachers or schools to be identified.

(b) If you are intending to make tape recordings or video recordings of subjects please answer the following questions:

(i) Will tape or video recordings be destroyed at the end of the project? YES / NO
(ii) If NO, what further use do you intend to make of the recordings?
(iii) Will consent be requested for this future use? YES/NO

23. STATE ARRANGEMENTS FOR INDEMNIFICATION IN THE EVENT OF INJURY TO THE SUBJECTS

N/A

24. PROJECT DURATION

(i) When do you hope to commence the project? Initial contact to be made with schools in September 2004.
(ii) When will the project finish and how long will it take to complete?
The project will begin during the forthcoming academic year (2004-05). Exact starting period and length of time of participation will vary according to the requirements and availability of each institution but it is anticipated that ten or more sessions (lessons) will be involved in work for the project.

SECTION C NOTES

Application must be submitted at least two months before the expected start of the project.
Major modifications in the course of the study should be resubmitted to the Ethics Advisory Committee for approval.
You should submit a report at the close of the project on form EC3, available on the University's website, or on request from the REDSS Office.
Adverse events of a serious or potentially serious nature should be notified directly to the University Health and Safety Adviser.

SIGNATURE OF INVESTIGATOR:  DATE: March 2004

SIGNATURE OF SUPERVISOR/ACADEMIC TEAM LEADER: DATE: .....

SIGNATURE OF CHAIR OF BOARD OF STUDIES: DATE: .....

.....

WHEN COMPLETE, PLEASE RETURN THIS FORM TO THE SECRETARY OF THE ETHICS ADVISORY COMMITTEE

Following approval by the Board of Studies, this form should be forwarded to the Secretary of the Ethics Advisory Committee, Chris Millward, Research and Economic Development Support Services, Old Shire Hall.

Approved / Not Approved by Ethics Advisory Committee

..... Date: .....

Appendix 10b

Letter to schools requesting involvement

3499
3499
stewart.martin@durham.ac.uk

Dear

Research Project – English Literature and ICT

I am a full time member of staff at the University, based at the School of Education. I lecture on our taught PhD on the uses of Information and Communication Technology (ICT) in educational institutions and also on our specialist BSc Ed ICT degree which provides students with QTS.

I am currently setting up a research project and write to ask whether your school, as one of our active partnership schools, might be interested in taking part. The project is focussed on the use which may be made of ICT by students who are studying English Literature for external examinations.

The project would involve some of your students using a specially developed piece of software during their English Literature course to see what difference it made to the effectiveness with which they learned about particular texts and whether their subsequent academic understanding and performance was improved.

I would wish to involve teachers in the discussion of the research design, the identification of suitable students and in facilitating the sessions, although I do not expect that this would consume a lot of their time. No prior expertise in the use of ICT is required of the teaching staff who would be involved although some familiarity would be helpful and I am happy to provide this, should your school become involved in the project. This is not a project which requires teaching staff to be 'tekkies' – it is intended instead to discover how ICT might best be integrated into Literature study to benefit students, teachers and schools as a whole.

There would be no need for your students to work other than at the school and the project is not intended to require any additional curriculum time. No research published as a result of the project would permit the identification of individual schools, teachers or students, nor would such be disclosed to any third party without your prior written approval. The results of the research would be made available to the schools involved and it is our intention that this (together with their involvement in the project) would enable schools to: improve the effectiveness with which they use ICT in the classroom; improve teachers' confidence and familiarity with the use of ICT in their teaching; and possibly therefore improve the examination results of students studying English Literature.

In order that the project is as useful as possible to participating schools, I have concentrated on building software only for a small number popular study texts in English Literature. You may therefore be especially interested in taking part in the project if your English department were intending to use during the coming academic year of one of the following titles:

Animal Farm by George Orwell
Great Expectations by Charles Dickens
Lord of The Flies by William Golding
Macbeth by William Shakespeare
Of Mice And Men by John Steinbeck
Roll of Thunder Hear My Cry by Mildred D. Taylor
Romeo and Juliet by William Shakespeare
To Kill A Mockingbird by Harper Lee

During the project students would require a reasonable amount of access to a fairly standard multimedia PC, either stand-alone or networked, in order for them to use the software. Minimum hardware requirements for the PC would be 486D x 100 processor, 16 MB of RAM, Windows 3.1 or higher, a graphics card and monitor capable of running at 640 X 480 with 256 colours, 16 bit soundcard, speakers (or headphones) and CD drive. A printer connected to the PC(s) would be necessary. Access to the Web via Netscape or Explorer internet browser would be helpful but is not essential.

If you would like to be involved in the project, please contact me via telephone, e-mail or Fax. so that we can set up an initial meeting at a mutually convenient time to discuss the project. If it is more appropriate or convenient, an initial meeting could of course be with a member of your senior management team, the Head of your English department and/or a nominated contact teacher.

I hope that you will be able to become involved in this interesting research project and I look forward to hearing from you.

Yours sincerely,

Stewart Martin

Appendix 10c

Letter to schools about informing parents

3499
3499
stewart.martin@durham.ac.uk

The Head teacher
xxxxx

Dear Head teacher

Research Project – English Literature and ICT

I am pleased to be able to write and confirm that following the very positive meetings and discussions I have had with yourself and your English departmental staff I am now making arrangements to go ahead with the above research project with your school. Work with students will begin quite soon now and I would therefore like to thank you for agreeing to take part in what I am sure will prove to be a worthwhile and interesting project for your staff and students.

In order to comply with our policy on ethical research, I have enclosed a draft letter which is addressed to parents. I would be extremely grateful if, having read it, you would be prepared to include it (or the text from within it) in one of your routine communications to parents between now and the end of this term, before the project starts. As you will see, the enclosed letter explains in general terms what the project is about and asks parents to contact the school if they have any objections to their child being involved.

I hope that no one will wish to opt out of the project in this way and it is rare for anyone to do so, but for ethical reasons we need to have been seen to put in place a mechanism which allows parents to withhold permission for their child to take part. If you, your PTA or your Governing Body would prefer that we ask every parent to give us positive permission for their child to be involved please let me know and I will make the necessary arrangements to send you the printed materials for this. If there are any particular queries which arise I will of course be pleased to answer them and I am happy to come along to the school again to speak to the PTA or Governing Body if this would be of help.

Please do get in touch if you have any questions or concerns about the project or if you would like any further information. May I once again thank you for allowing your school to be involved.

Yours sincerely,

Stewart Martin
cc. Project contact teacher / Head of English

Appendix 10d

Letter to parents

Tel: 0191 334 8371
Fax: 0191 334 8311

stewart.martin@durham.ac.uk

Dear Parent,

Research Project – English Literature and ICT

This academic year your child's school, along with a number of other carefully selected schools in the North East, is taking part in a research project run by the University of Durham. The project is about English Literature and will mean that your child and their teacher will use specially produced computer software which has been designed to improve learning.

The Head teacher and the English Department at the school have approved this material and wish to use it because they think it will help children to make better progress. Your child would use the software at various times in class. As part of the research your child will also be asked to complete a questionnaire about how they like to learn and a short quiz about one of the books they are studying. During the course of next year we may ask your child to tell us more about how useful they think these new learning materials are and how they are progressing with them. Your child will be asked to evaluate their own learning and progress and how they, their teachers and the project software can make this even better. They will not be asked for private or 'personal' information. Details about your child's responses will remain confidential.

Based on trials already conducted, we expect that your child will find the software interesting and fun to use.

If you are happy for your child to be involved in this project you need do nothing. If, however, for any reason you would prefer your child not to take part in this project and do not wish them to use these new materials, please write to the school and say so.

Yours sincerely,

Stewart Martin

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Teachers using learning styles: Torn between research and accountability?

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ABSTRACT

The proliferation of instruments reporting learning/cognitive style with school pupils is of particular interest, because most research on them focuses on applications in higher education, training and the adult workplace, where criticisms of their integrity, reliability and validity have been significant. This study examines two such popular instruments in highly effective schools in England, UK. Neither instrument demonstrated reasonable internal consistency or results according with theoretical constructs. Concerns about their usefulness in these contexts are explored. Reasons provided by faculty for their use were: face validity; external inspection; professional accountability; institutional policy; the legacy from initial training; established classroom practice.

The use of instruments reporting individual learning or cognitive style is attractive for educationalists, especially within high-accountability educational systems, where schools face rising pressures to reach or improve upon high levels of student performance in public examinations and to promote individualised learning. One favoured approach for attaining higher performance levels advocates matching teaching methods to student's learning styles. This appears to address imperatives for increases in performance and for more individualised learning and is also particularly attractive to those who argue that many students are not well served by traditional approaches to teaching, learning and content. However, serious reservations and doubts about the value of learning style metrics have been raised (Coffield, Moseley, Hall, & Ecclestone, 2004a) although, curiously, this does not appear to have significantly affected their increasing adoption and continued use by teachers; this article reports a study investigating the use of two popular learning-styles instruments in the UK and possible reasons for this situation.

One of the strongest advocates for learning styles, Kolb (1984), argued that despite the efforts made to assist the learning process in different educational contexts and subject areas "the weakness of nearly all these … is the failure to recognise and explicitly provide for the differences in learning styles that are characteristic of both individuals and subject matters" (Kolb, 1984, p. 196). He argued that one of the main benefits of addressing this problem would be that teachers would understand better the different ways in which their students learn and therefore be more able to enhance their educational performance. Kolb introduced one of the most influential and widely used instruments within the field of cognitive style with his Learning Styles Inventory (LSI), developed in 1984 and subsequently revised (LSI-2) in 1985 (Kolb, 1984, 2005). Kolb's instrument is based on the claim that effective learners rely on four different learning styles: *concrete experience*; *reflective observation*; *abstract conceptualisation*; and *active experimentation* and that learners and teachers can use the LSI to accurately identify the relative importance of each of these stages, understand which they tend to emphasise and thereby improve their knowledge of themselves as learners and teachers.

Questions in the LSI ask respondents to indicate, for example, whether they "learn by feeling/watching/thinking/doing" and to indicate how strongly each of these alternatives applies to them by ranking the four modes from 1 to 4. Four summed scores are used to identify which of the four learning styles most represent the respondent's preferred style. The first (1976) version of Kolb's LSI was criticised for its lack of stability, poor reliability and susceptibility to response bias (Allinson & Hayes, 1990; Sims, Veres, & Shake, 1989). Some concluded that its outputs were "obfuscated by an inordinate amount of error variance" (Freedman & Stumpf, 1978, p. 281). The revised LSI-2 was found to have adequate or good levels of reliability (Heffler, 2001; Veres, Sims, & Locklear, 1991) although there remained concerns about the adequacy of its reliability, its construct representation, the way in which latent

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constructs have been derived, and the approach adopted to representing styles (Wierstra & De Jong, 2002). Using factor analysis, Freedman and Stumpf (1978) found only weak support for the theory, and that less than 5 per cent of between group variance could be accounted for by knowledge of learning styles. Newstead (1992, p. 311) was more critical, claiming that "the factor structure emerging from a factor analysis bore only a passing resemblance to that predicted by Kolb" and the scales correlated poorly with academic performance (cf., Cornwell, Manfredo, & Dunlap, 1991; De Ciantis & Kirton, 1996; Duff & Duffy, 2002; Geiger & Pinto, 1991; Geiger, Boyle, & Pinto, 1992; Tepper, Tetrault, Braun, & Romero, 1993; Wierstra & De Jong, 2002). Such studies "constitute a serious challenge to the construct validity of the LSI" (Coffield, Moseley, Hall, & Ecclestone, 2004b, p.66).

An alternative learning styles scale was developed by Honey and Mumford (1992), who share Kolb's view that learning is strongly influenced by intrinsic preferences that give individuals a liking for certain approaches over others. Their Learning Styles Questionnaire (LSQ) includes 80-questions aimed to measure an individual's intrinsic learning preferences: *Activist*, *Reflector*, *Theorist*, and *Pragmatist*. The classification structures used by Kolb and Honey and Mumford are very similar and despite some small differences of nomenclature the two instruments map onto each other closely at the theoretical level. The LSQ has been criticised, however, as an unsatisfactory alternative to Kolb's instrument (Allinson & Hayes, 1990; Duff & Duffy, 2002), although some find it a good replacement as it is claimed that the LSQ involves a better conceived learning process model (De Ciantis & Kirton, 1996; Sadler-Smith, 2001). There have been concerns about whether the resulting classifications from the LSQ are more attributable to personal characteristics, situational factors, or measurement error than to any measure directly associated with learning (Stumpf & Freedman, 1981), or due to personality and not learning features (Caple & Martin, 1994; Duff & Duffy, 2002; Furnham, Jackson, & Miller, 1999; Jackson & Lawty-Jones, 1996). Because all items present the four styles in the same order, some have argued that this can lead to 'positional response' confounds (Atkinson, 1988; Cornwell et al., 1991; Veres, Sims, & Locklear, 1987; Veres et al., 1991; Wierstra & De Jong, 2002) and thus bias the scoring. Factor studies have not been supportive of the four-factor structure, and have found the LSQ unable to discriminate between the theoretical styles it purports to measure (Fung, Ho, & Kwan, 1993; Swailes & Senior, 1999). This low reliability and poor factor structure mean that the LSQ has little promise as a predictive instrument (Smith, Sekar & Townsend, 2002; Zwanenberg & Wilkinson, 2000, p. 379). The studies matching teaching methods to these learning styles have been inconclusive and inconsistent with the instrument's basic hypothesis (Allinson & Hayes, 1990; Garner, 2000), and the matching has not led to increases in achievement (McNeal & Dwyer, 1999). The ineffectiveness of such matching may be attributable to what Argyris described as the difference between *espoused theory* and *theory in use* (Argyris, 1976) – that is, the difference to be found between what individuals say they do and what they actually do. Learners may identify a particular approach to learning as the one they most frequently use but unless this is experimentally verified we are unable to determine the accuracy of such reports and a learner may well employ entirely different strategies in practice to those they consistently report in good faith on questionnaires or during interview. This problematic limitation of instruments employing self-reporting (see Veenman, Prins, & Verheij, 2003) has featured in other studies and has led some to conclude that as a result of this and other concerns the LSQ is "invalid and unreliable as a measure of preference for instruction and as a predictor of academic performance" (Price, 2004, p. 695).

One of the fundamental measurement problems of the LSI is that it uses ipsative scoring, where respondents are asked to rank the four styles for each question. This introduces many measurement problems such as difficulty in meaningfully summing ranks across items – because a high score on one dimension forces correspondingly low scores on others. When comparing scores between subjects this forces negative correlations between these high and low scores, which leads to lower estimates of reliability, causes misleading factor patterns, and limits interpretability (Henson & Hwang, 2002; Hicks, 1970; Loo, 1999; Wierstra & De Jong, 2002). Kolb's defence is that this ipsative nature invites respondents to compare learning modes and gives the LSI 'ecological validity' – that is, it imitates the reality in which a learner makes choices between different ways of learning, so lessening the tendency to acquiesce to the norm of socially desirable responses because the choices offered are all of equal social desirability (Kolb, 1981; Smith & Kolb, 1986).

These criticisms have not stopped the bandwagon effect of advocating learning styles for use by teachers to better enhance students' learning, or their continued use in many schools. It is also noted that a systematic comparison of 71 different models of learning styles concluded that whilst the LSI-2 and LSQ had been found by some to possess reasonable test–retest reliability, both lacked construct and predictive validity, there is insufficient evidence of internal consistency, and that despite revision these scales "should not be used as the theoretical justification for changing practice" (Coffield et al., 2004a, p. 139). This too has not stopped many teachers using these scales and basing teaching and learning decisions on the consequential results from these tests. The present study was designed to explore whether, therefore, given the close conceptual equivalence of the LSI-2 and the LSQ, they produce comparable outputs for a sample of secondary (K11–K13) students in the UK and whether there is empirical evidence for the four learning styles. Additionally this study sought to discover whether these instruments produce worthwhile information for teachers and how teachers faced with the research evidence concerning the value of these instruments would respond.

1. Method

Several secondary schools used by a university in the North-East of England, UK, for placing trainee teachers during the school-based phases of their program identified themselves as making use of instruments claiming to measure pupil learning styles. These schools made systematic use of such instruments by requiring faculty to use data gathered from them to inform classroom pedagogy or to develop regimes of skills-teaching and assessment. Each school had at least one member of staff with special responsibility for overseeing this work and for training other teachers in the use of these instruments. These individuals had often been on special learning styles training courses and were highly promoted within their school – occasionally their responsibility for learning styles was subsumed under their work as a head of department, sometimes it was independent of subject responsibility and in a few cases it was a significant part of the work of one of the school's deputy heads. These schools continued to invest substantial resources in the use of learning styles and one purpose of the present study was to explore the actual and perceived value of this investment.

Four schools were selected from the above sub-group for the present study on the grounds that within the previous eighteen months they had been subject to government inspections which in their resulting reports identified them as highly successful or outstanding. The designations 'highly successful' or 'outstanding' by government inspectors carry significant currency within the UK; these are desirable government-endorsed judgments of the quality of educational provision which lead to associated benefits and also less

intrusive inspection in the future. Inspection reports are published online and so praiseworthy inspections are useful to schools in promotional publicity, such as when seeking to recruit the most able and skilled faculty and to parents when selecting the school they wish their children to attend. As the level of a state school's funding is closely linked to the number of pupils on its roll, increased competition for places at those which are perceived to be most successful ensures such schools receive maximum income and acquire high status within their community. Inspection judgments are also referenced by the internet search engines of estate agents (realtors) and have a strong influence on the prices that can be commanded for residential property closest to schools judged to be very successful. There is a powerful incentive, therefore, for schools to strive for positive outcomes from government inspections (Atkinson, 2003).

The schools in this study also had in common that in their reports their inspection teams also noted that faculty were highly skilled at identifying pupils' individual learning needs and in meeting them with a range of different, effective, individually targeted teaching and learning strategies. In many other respects the schools were broadly similar, despite serving communities providing student intakes of differing average levels of ability. Inspectors noted in each school that teachers knew and taught their pupils well, had high expectations of them, matched classroom activity well to their needs, got them to make effective use of a wide range of research skills, were adventurous and imaginative in their teaching and used a variety of teaching and learning styles effectively. Inspectors also commented that achievement in external examinations was good and teachers knew how to match their teaching styles and learning materials effectively to pupils' different requirements. The inspection teams in each of the schools noted that they found no significant differences between the achievements of girls and boys. These schools had been judged to provide excellent teaching and learning opportunities for students and had between them made use of several instruments designed to assess learning styles. Their inspection reports spoke favourably of their use of measures of learning styles to inform pedagogy and commented that such approaches were a key element in their success at matching instruction to individual students. There was therefore a high level of professional and government approved public support for the effectiveness of these schools' use of learning styles to sustain high levels of effectiveness and individualised learning.

The schools featured in this study had in common substantial experience with and reliance on both the Learning Styles Inventory (LSI-2) developed by Kolb, Osland, & Rubin (1995) and the Learning Styles Questionnaire (LSQ) produced by Honey and Mumford (1992), which were therefore chosen as the focus for the present study.

1.1. Participants

A sample of 394 Key Stage 4 (K11–K13) students in the North-East of England were selected using the above method and complete sets of matched data were obtained for each subject (141 boys, 253 girls) from the LSI-2 and the LSQ from the 16 classes taught by 18 different subject specialist English teachers in the selected schools.

1.2. Instruments

Kolb's Learning Styles Inventory (LSI-2) and Honey and Mumford's Learning Styles Questionnaire.

1.3. Procedure

Data were gathered from students from English Literature GCSE lessons only, collected during one class period in this subject with their normal teacher present by asking all participants to focus only on their learning with regard to that subject and context when completing the Kolb LSI-2 and the Honey and Mumford LSQ consecutively as part of a normal Year 11 GCSE English Literature lesson.

To minimise the possibility of a response bias in the LSI, the order of the alternatives was adjusted so that each of the four modes appeared with equal frequency within the first, second, third or fourth position in the questionnaire. This was intended to prevent a positional response set appearing in the LSI data, which several studies have identified as a potential weakness (Atkinson, 1988; Cornwell et al., 1991; Veres et al., 1987, 1991; Wierstra & De Jong, 2002) whilst others note that such an approach much improved its reliability (Veres et al., 1991).

Qualitative data were gathered by the researcher from the 18 teachers involved in the study via recorded semi-structured individual interviews and group de-briefings (three groups of 5–7 teachers, composed according to mutual availability). Individual interviews and group de-briefings were of approximately twenty and forty minutes respectively: the former conducted both before their students completed the LSI-2 and LSQ and also as a follow-up reflection at a time convenient for each teacher within the week following; the latter in the second week following the last questionnaire completions. The second individual interviews were used to reflect to teachers the material from their first interview in order to identify content of persistent validity and confirm interpretations. The schedule for all interviews included open-ended questions inviting respondents' views on the applicability and value of the outputs from the LSI-2 and LSQ; their reflections on the value placed on learning styles by inspectors, parents and school management; their awareness of relevant research; their rationale for the views they held; and opportunities to volunteer any additional comments. Interviews and group discussions were transcribed verbatim and content analysis applied to reveal common themes and dynamics and identify matching perceptions (Newby, 2010).

2. Results

Honey and Mumford concur with Kolb that referencing an individual's scores to the relevant wider population mean is important. The scale means for students in the present study were therefore used for analysing outputs from the LSQ to replace those from the reference groups used by Honey and Mumford and those from that used by Kolb for the LSI and to calculate the origins for graphical representation (Table 1).

The UK students had lower means as Reflector, Theorist and Pragmatist compared to Honey and Mumford norms, and were more Divergent but lower on Assimilator and Convergent than the Kolb norms. There is supposedly equivalence between Theorist (20.3% of the current sample) and Convergent (26.3%); Activist (17.1%) and Divergent (29.2%); Reflector (28.4%) and Assimilator (19.7%); and Pragmatist (34.2%) and Accommodator (24.7%).

A cross-tabulation between the assigning from the two instruments indicated some overlap (chi-square of 13.06, $df = 9$, $p < .014$), but when the more appropriate measure was used that corrects for chance effects in this comparison there is clearly no common meaning across these measures (Cohen's Kappa = .071).

This lack of relationship is also reflected in the very low correlations (r) between the corresponding scales and the equally low percentage of variance explained by them (in parentheses). The correlations between the supposed similar constructs are Divergent–Activist .047 (.2), Accommodator–Pragmatist .24 (5.9), Assimilator–Reflector –.02 (.02) and Convergent–Theorist .13 (1.8). Such figures indicate that theoretically related scale elements associate mostly by chance even when correlations are statistically

Table 1
Mean scores, standard deviations and effect sizes (d) of population samples for the current study compared to those from Honey and Mumford's reference data from 21,216 individuals (2007) and those for Kolb's reference group of 6977.

	Current		Honey & Mumford				Current		Kolb		
Style	M	SD	M	SD	ES	Style	M	SD	M	SD	ES
Activist	10.58	4.14	9.7	3.7	0.22	Divergent (CE)	32.98	4.15	26.2	6.9	1.22
Reflector	9.37	4.19	13.7	3.7	−1.10	Assimilator (RO)	26.65	3.85	29.8	7.0	−0.58
Theorist	6.89	3.46	12.3	3.3	−1.60	Convergent (AC)	26.70	3.90	30.8	7.2	−0.74
Pragmatist	8.35	3.65	12.9	3.0	−1.37	Accommodator (AE)	33.67	4.37	33.1	6.5	0.11

strongly significant (Table 2) and that element components explain very little of the variation in individual student scores. A teacher making a judgment about an individual learning style could therefore place a student in quite different classifications, depending on the test used (Table 2). This is also illustrated in the different percentages of respondents extracted by the two instruments in the diagonal compared to the off-diagonals (the % in the diagonal should be much larger than the off-diagonals) (Table 3).

The subscales of the LSI-2 also appear to have poor estimates of reliability, producing coefficient alpha values from .28 (AC), .31 (RO), .40 (CE) or .40 (AE), whereas those for the LSQ appeared to be better: Theorist .71, Pragmatist, .72, Activist, .78, Reflector, .79. Together these results suggest that the LSI is the weaker of the two instruments and at best provides random numbers (see Thissen & Wainer, 2001).

A maximum-likelihood factor analysis with oblique rotation was used to investigate the underlying constructs within the data for the LSI-2 and LSQ. This is the appropriately rigorous extraction method when, as in the present study, the data set is complete and there are no missing items. Initial analyses showed a large number of items that did not load on any of the four expected factors. Further, no matter how the items were reduced, the items on Reflector and Theorist refused to separate into two distinct factors. The best subset of items were retained and a restricted factor (over-identified) model was specified (Fig. 1) using AMOS (Arbuckle, 2003). The fit of the four factors was acceptable (chi-square 796, df = 489; RMSEA = .040). The correlation between the Reflector and Theorist remained very high (r = .87) questioning whether these are measuring two distinct factors. The estimates of reliability are barely adequate, even for this best subset (Activist .62; Reflector .78; Theorist .66; Pragmatist .54).

The first two factors in the LSI-2 may be interpreted as hinting at dimensions of 'watching/feeling' versus 'thinking', but the interpretation is only weakly supported by the analysis and is compromised by incoherent expression within the variables. Together all four factors explain only 21.4% of the variance. A two factor extraction, following the approach of Wierstra and De Jong (2002, p. 435) failed to replicate their findings for factors for 'thinking versus doing' and 'feeling versus watching' and explained little of the variance (16.3%). The results of both the four and two component analyses in the present study are clearly at variance with the expectations of Kolb's theory.

Table 2
Correlations (r) between the LSQ and LSI-2 outputs. Theoretical equivalences in bold type.

	LSQ (Honey & Mumford)			
LSI-2 (Kolb)	Activist	Pragmatist	Reflector	Theorist
Divergent	**.047**	−.141(**)	.004	−.080
Accommodator	.173(**)	**.243**(**)	−.033	.063
Assimilator	−.170(**)	−.183(**)	**−.015**	−.121(*)
Convergent	−.077	.057	.047	**.133**(**)

**Significant at the .01 level.
*Significant at the .05 level.

The theoretical model for the LSQ requires each extracted component to load strongly from its associated twenty questionnaire items. Only 26% of items were, however, found to match any construct to a statistically significant degree and many of the items within each theoretically associated group of questions did not load uniquely against any single extracted factor; *Reflector* loaded into its strongest component from 40% of theoretically relevant questionnaire items; *Activist*, *Theorist* and *Pragmatist* from 10%.

The extracted factors between them explained relatively little of the total variance for either instrument (LSQ = 15.0%, LSI-2 = 21.4%), items did not load on factors as predicted and no coherent match was identified between items and the theoretical constructs in either model. Similar incoherent loadings and low values for the variance explained by a four-factor solution (e.g. 31.9%) have been found for the shorter (40-item) version of the LSQ (Klein, McCall, Austin, & Piterman, 2007).

3. Discussion

Teachers in these schools would have as much information if they assigned the learning styles randomly to students rather than using the Kolb test. They might have more confidence in the LSQ, but the factor structure shows there is still much cause for concern about this scale. The estimates of reliability for the best subset of items are still too low and the correlation between some of the factors is too high. Despite using similar descriptors for their respective classifications, the Kolb's LSI-2 and Honey and Mumford's LSQ did not create similar classifications. No systematic or statistically significant correlation between the outputs from these instruments was found, and there is a lack of construct validity for either instrument. Whilst the internal consistency of the LSQ in the present study is similar to previous studies (e.g., Sims et al. 1989), a more recent examination of the shortened (40-item) version with 66 postgraduate students in Hong Kong found values between 0.25 and 0.50 (Klein et al., 2007), which are well below the level considered adequate for research applications.

There was some agreement, but not sufficient to inspire confidence, between the two instruments, and this replicates Sims et al. (1989), who after examining the construct validity and convergence of Kolb's LSI-2 and the LSQ with 279 students in two universities in south-eastern USA found little supporting evidence and questioned whether either had effectively operationalised their constructs (cf., Goldstein & Borkos, 1992). Some research has proposed that it is probable that the LSI may return different results for different

Table 3
Percentages of respondents extracted for the Kolb's LSI-2 (down) and Honey & Mumford's LSQ (across).

	Activist	Pragmatist	Reflector	Theorist
Divergent	**38**%	28%	32%	19%
Accommodator	22%	**27**%	26%	22%
Assimilator	20%	18%	**21%**	19%
Convergent	20%	27%	20%	**39**%

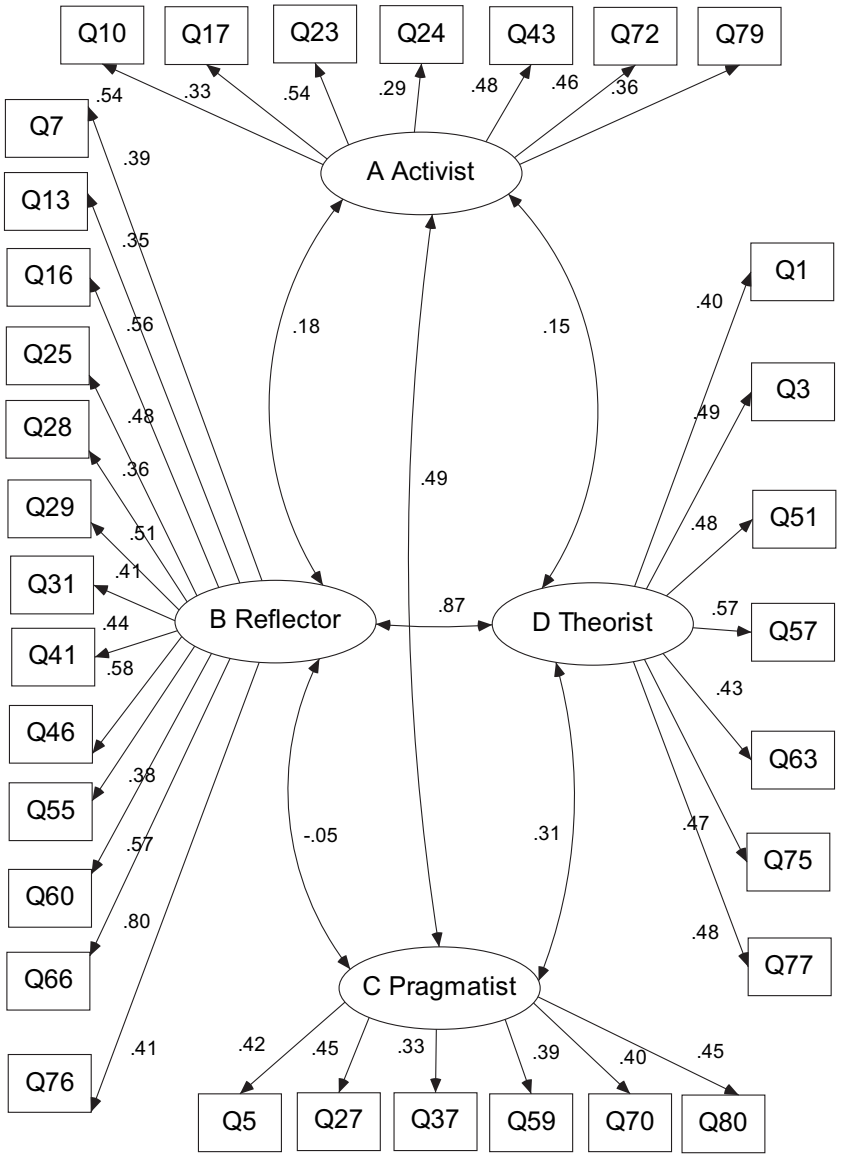

Fig. 1. Restricted factor model for the LSQ.

subject areas and academic levels (Henson & Hwang, 2002) and the present study sought to explore this possibility within a little-explored population where both the LSI and LSQ are increasingly used. However, as discussed below, there is no evidence from the present study that should allow teachers or others to feel confident that using these two instruments will be of benefit to learning or teaching English in the UK secondary (K11–K13) curriculum. However, their use was perceived to have tactical value in defending teachers' own professional image, identity and authority within the classroom.

The extended de-briefing discussions and follow-up interviews with teachers in the schools involved were conducted both to outline and explore the wider research background to the LSQ and LSI discussed above and to explore the findings of the present study using their students. It was noteworthy during these group and individual discussions how many faculty in all of the schools remained unperturbed by the results from the present and other studies. Teachers felt these findings would have no affect on the continued use of one or both of the LSI-2 and LSQ in future, either by themselves or teachers in other schools. A number of reasons were advanced for this, which between them highlight the complex dynamics operating upon teacher pedagogy and instructional management within these classrooms and schools and the important influence on these of teachers' perceptions about how their own school management hierarchy and external agencies come to make judgments about the professional competence and performance of teachers. Interviews revealed that teachers' reflections were informed by a number of concerns, perceived pressures and considerations which it was possible to differentiate from interview content analysis into six vectors operating semi-independently: face validity; inspection; accountability; school policy; initial training; and pedagogy.

The first perspective upon which teachers drew heavily was that of *face validity*. Most of the teachers in the study conceded that they had been strongly influenced by the perceived face validity of the learning style instruments, which seemed to them to accord with the 'common sense' premise that if children do not all learn in the same way, teachers cannot teach them all in the same way (Table 4).

Several teachers variously expressed another common view about the originators of the LSI, the LSQ and similar other

Table 4
Extract of post-intervention teacher reflection – face validity.

Everybody acknowledges that children are all different and there is plenty of research that emphasises why and how we should differentiate practice. So I don't see why we shouldn't be using learning styles as part of classroom activity. *Teacher 'A'*.
Children are still developing their approaches to learning and it's likely that these haven't settled down into a fixed approach yet. *Teacher 'C'*.
Maybe these instruments aren't very good at measuring learning style, or perhaps they are only useful with adults or in industry, but that doesn't mean that the principles behind them are not useful. *Teacher 'D'*.
The research results do concern me, but I know that differentiating content and approach in my classroom makes children learn more effectively, even if only because they are more motivated, so these results don't change that. *Teacher 'G'*.

instruments of which they had experience: "these people are academics who have websites and they're backed by impressive publishing companies – if they were no good they would have gone out of business years ago". This tendency to ascribe value to well-known or enthusiastically promoted educational approaches of dubious or unknown warranty has been commented on elsewhere, where it has been concluded that it increasingly trivialises the complexity of learning (Sharp, Bowker, & Byrne, 2008).

A second theme to emerge from teachers' interviews was focussed on the implications for *inspection* (Table 5). Teachers pointed out that the strong performance of each of the schools in their recent inspection had actually increased the likelihood that they would continue to use the LSI-2 and LSQ, irrespective of any identified reservations or failings. This was because institutions that had been judged to be 'excellent schools' might feel under particular pressure to demonstrate to parents and government that they embraced the use of measures of individual difference, in line with government policy encouraging this philosophy, and to show that these were being employed in the classroom. It seemed to several of the teachers interviewed that it would be very difficult for their school to defend their award of excellence whilst rejecting students' individual differences. For most parents, governors on the school board and also for some school managers and many inspectors, the use of learning styles was perceived by teachers to be an attractive and easily absorbed message that individual student differences were being effectively accommodated into their practice. The pressure to use learning styles was perceived to be further increased by a good inspection report because it strengthened the school's need to proactively develop further its own evidence base in order to maintain the school's favoured position and minimise the possibility of a more rigorous future inspection. The teachers in the study were united in their view that school inspectors favoured the use of learning styles, were impressed by their use and saw this as evidence of a seemingly rigorous approach to measuring and employing individualised student learning (see Department for Education and Skills (DfES), 2004; 2007).

However, the approach adopted by the UK government to identifying 'highly successful' schools was regarded as deeply flawed by many teachers in the present study, despite the favourable reports returned on them and their institutions. Teachers ascribed their lack of confidence in government accolades as due to the use of inspectors they perceived as less experienced or qualified than themselves and to their perception that inspectors were obliged to use government imposed approaches, prescribed language and protocols they perceived as discredited. These teachers reported intensified frustration with inspections when the outcome was a favourable report, commenting that poor reports, however unwelcome and damaging to themselves and their schools, were at least able to be dismissed by them as lacking professional credibility and authority. Favourable reports, on the other hand, whilst welcome, left many of these teachers feeling that in accepting them they had been coerced into conspiring to support a system of which they strongly disapproved.

School inspectors' concerns about seeing teachers match individual pupil differences to varied provision within lessons presented particular challenges to be met by practitioners, according to teachers in the study, which made the use of the LSI-2 and LSQ more likely. This was because they felt that in order to strengthen the likelihood that they would be perceived as an expert practitioner, teachers needed to provide objective evidence to support the identification of individual differences that, crucially, *did not rely only on their unsupported professional judgment*. The role of *professional accountability* influenced teachers in all of the schools in the study.

For many schools it may be the case that the LSQ and LSI-2 possess considerable face validity and that this is the most significant factor in explaining why they make extensive use of their outputs to inform pedagogy and influence assessment strategies. In the schools in the present study the judgments of external inspectors clearly also contributed to the continued use of learning styles (Table 6). Despite this one might imagine that the evidence from the present and other studies would make these schools seriously reflect on the damage they may be doing in believing that these scales have meaning when their outputs may be no better

Table 5
Extract of post-intervention teacher reflection – inspection.

I have lots of friends in other schools who say it's the same there as it is here … management thinks using (learning) styles shows we are professional, because we're using tests to measure ways of learning – and parents like it too, because they do seem to make sense, don't they? They make a lot more sense to parents than the SATs, which the pupils hate too and I think are a waste of time, but you notice that the government backs them without questioning whether they work, doesn't it? *Teacher 'B'*.
It's not what I would do if I had the choice, but so much is dictated these days and you can't afford to go out on a limb in case you get a bad (inspection) report. I don't take them too seriously but they seem to impress the LEA and it looks good in the prospectus. *Teacher 'M'*.
One or two of our governors are enthusiastic about them and they're very supportive of the school, so the Head likes us to be seen to take their ideas seriously. *Teacher 'J'*.
The Deputy (Head teacher) in charge of this is really sold on these things and she's made it a real feature of work here – she gives presentations at Parent's Evenings about how we use learning styles and there's always an impressive display of the kids' work to show how we use all the different styles. How do you climb down from that? *Teacher 'G'*.

Table 6
Extract of post-intervention teacher reflection – accountability.

The inspector who observed my lessons said I was an 'outstanding' practitioner and he made a point of commenting favourably on the way I used learning styles – he thought it was, well, really professional and showed how I used evidence to inform practice. He seemed quite impressed by it. *Teacher 'A'*.
What would you say to the inspection team next time they came if you'd stopped using them? *Teacher 'E'*.
These days it's not enough to say you have decided to do things a certain way because that's what your training and experience indicates is best to you. That's not 'objective' and people are much more likely to challenge a professional judgment. It was different when I started teaching but times have changed – it's less about what *you* think now, however professional you might be seen to be, and more about exam results and covering your back. *Teacher 'F'*.
You can say that doing things a particular way is in your opinion the best for a particular child and you can tell them (inspectors) that you use your judgment to plan what would be best to do next, but what are you going to say when they ask you where your evidence is? It's not that they're unpleasant or aggressive, but that they've got their own tick-list of things they're looking for and what they think does and doesn't count as best practice. *Teacher 'L'*.

than random numbers. However, there were other influential factors operating within these schools and suggestions that, like those for *face validity*, *accountability* and *inspection*, these may also operate more widely.

Several teachers reported that they were in any case required by *school policy* to show how they made use of measures of learning style in their lesson planning, which was monitored weekly, so abandoning them was not perceived to be an option, particularly in two of the schools where a member of senior management had oversight of learning styles as part of their role (Table 7).

Many teachers also recalled that during their *initial teacher training* they had attended lectures about learning and teaching styles where the various instruments used to provide measures of these were advocated for use without significant attention being drawn to research that questioned their efficacy or educational value (Table 8). This seems surprising but almost all the teachers involved confirmed that they were unaware of the body of research critiquing learning styles and associated instruments. Teachers claimed they had no recollection of being exposed to this information during their training and further study and that since that time they had had relatively little (in most cases no) contact with research literature. The teachers involved in this study felt that they were not unusual in excluding the places where research was published from their customary reading. Most commented that apart from relevant professional press (read by about two thirds of teachers in the sample) any reading they engaged in about their work was confined to government reports or policy documents with which they were required to comply. This may not just be about the way these teachers perceive the relevance or importance of peer-reviewed research. It may also in part be an outcome of a more prescriptive approach to the training of teachers and of a more highly directed curriculum and associated pedagogy (Somekh, 2000). Teachers' lack of familiarity with research that is critical of particular educational interventions may also be related to the difficulties sometimes experienced by academics in securing publication for negative findings.

Finally, the perspective of *pedagogy* was invoked by many interviewees. Teachers commented that in addition to the factors already raised, they were relatively unperturbed by the lack of reliability and validity of the LSI-2 and the LSQ because they found the underlying (face validity) premise of these instruments convincing (Table 9). Any failure of these instruments to work reliably at the level of the individual student was not therefore seen to be of great importance; most of the teachers in the study commented that they did not in any case differentiate their practice at the level of a specific, individual student in such a targeted way. Instead, whenever possible teachers provided a small number of different articulations of lesson content, some designed to appeal to visually oriented learners, others which they thought would appeal more to learners who preferred to engage in practical activity and so on, each often also differentiated by level of intellectual challenge. Which of these affordances and resources an individual student employed was often left for the student to decide for themselves and teachers reported that some students would use one of these and at other times several. In many cases, teachers reported that they would place worksheets addressing several of these alternative approaches and levels of challenge at the front of their class, where students could elect to pick them up or not. There appeared to be little intervention by many teachers at the moment of decision, either to explore or inform the student's rationale for their choice of a particular resource, or to emphasise to them the value of making a thoughtful, reflective and informed decision as opposed to one founded on random choice or whim. The majority of teachers reported that they most often tended to use these worksheets as material for students who completed their class work early and characterised them as 'extension' work although it was clear that this was not their only purpose. One teacher candidly described these resources as 'busy work' that she used to ensure that students were seen to be being kept occupied throughout the class period. Few records of this activity were kept by teachers and none by students and no teachers in the present study said they drew upon it to inform individual students' future learning. Teachers said they were more concerned that students felt encouraged to experiment and think about how they were learning than about whether the use of particular measurement instruments (or resources) produced meaningful outputs that were stable over time. The outputs from learning style instruments therefore had their greatest utility in "fending off" management and in addressing the requirements of inspection audits, as well as for deflecting pressure to modify their underlying classroom practice to conform with what were often seen and described by teachers as management 'hobby-horses' or government policy fads. Teachers saw value in the LSI-2 and LSQ as means to get students thinking about how they learned and for many of them that was sufficient to justify their continued use, despite the fact that very little evidence was offered to suggest that teachers made any structured use of their students' thinking about their learning. Research has shown that teachers' beliefs about pedagogy can be highly resistant to both change and to short-term interventions and the responses of teachers in the present study support this (Pajares, 1992; Phelan & McLaughlin, 1995; Wildeen, Mayer-Smith, & Moon, 1998) (Table 9).

Comments made by teachers in the present study are in line with findings that the (pre)existing beliefs of educators about

Table 7
Extract of post-intervention teacher reflection – school policy.

This is my first job and it's not a permanent post, so I don't think it's a good idea for me to rock the boat. Anyway, I don't really disagree with it – but it's school policy anyway. *Teacher 'K'*.
We were all asked what we thought about this a couple of years ago. Not everybody was keen but quite a few staff think using learning styles works well. The decision to use them was made by management and the governors. You can't really just say you don't agree and refuse to do it, especially as I'm Head of Department and it's me that has to check lesson planning for my staff every week and sign-off that they're following policy on this. *Teacher 'E'*.
The senior team are committed and as long as everybody supports it and works together on things like this, we can get a lot of benefit as a school. Part of being professional is about working with your colleagues. *Teacher 'D'*.

Table 8
Extract of post-intervention teacher reflection – initial training.

I don't agree with those who criticise (the use of learning styles) – I think it works and in my dissertation for my degree I got a good mark for writing about learning styles and showing how they can fit in well with individualised learning. *Teacher 'A'*.
Maybe partly it's because you don't see much research published about things that don't work, only things about people claiming that the stuff they've done is wonderful. *Teacher 'I'*.
I don't think I've come across any real evidence that there's anything wrong with learning styles. Most of the negative comment seems very statistical. I worry about that a bit, because it seems … well, almost contrived some of the time, you know? *Teacher 'G'*.
I can't remember the last time I read any proper research. When I was at uni(versity) I suppose. Most often now the debate seems dominated by what this or that report has said and more often than not those are written by government agencies. On the few occasions you hear politicians talking about what research has found out, it's that kind of thing they're talking about, not something that's appeared in a journal. Funny really, because it's often the other way round when people are talking about things like medicine. *Teacher 'J'*.

Table 9
Extract of post-intervention teacher reflection – pedagogy.

Well it (learning styles) certainly motivates many students I teach. They think it's interesting and it opens their eyes to different ways of learning. Most of them never otherwise think about how they learn. *Teacher 'C'*.
Some just struggle to understand why they can't understand something and don't know how to get past it. Getting them to think about learning styles can sometimes change that. *Teacher 'D'*.
I make use of whatever opportunity comes my way if I think it will help my students learn – (learning styles) doesn't really affect the way I work or my underlying philosophy and I don't think it changes what makes a good teacher good. *Teacher 'H'*.

pedagogy are likely to have a powerful influence on the conclusions they are inclined to reach about the merits of specific classroom practices (Becker, 2000; Hattie, 2009). The reflections by teachers in the present study on the perceived locus of control within their professional practice underscore the complexities that result when a performativity approach to teaching and learning meets teachers' desires for pragmatic solutions to the tasks they perceive to be most urgent and the pressures they feel most acutely.

Many teachers interviewed in the present study supported the proposal that individuals have preferred approaches to learning and argued that they routinely 'matched' these to individualised instructional approaches although discussion suggested that they actually adopted their own fairly standardised approach to classroom delivery for all their students. Typically, teachers said they promoted matching in class "through the use of different examples" or by "encouraging pupils to consider how different people might think about a given problem" or by providing "some concrete and some abstract ideas and situations to encourage different ways of thinking". Teachers' convictions about the efficacy of this approach rested heavily on their own experience and self-reinforcing notions of 'what works', rather than on any objective evidence.

When questioned about the effectiveness of matching individual styles to teaching approaches, many teachers admitted that little of this had actually happened in their classroom in any formal or structured way but reiterated that it was embedded or implicit in their practice. Some raised a logical and pedagogic objection; matching may actually be counter productive. They argued that this may be especially the case where prior learning has not been successful, perhaps because a student's choice of approach was poorly aligned to a given scenario and content, or when new content or an unfamiliar learning domain had been encountered where prior approaches were an unhelpful guide. It was argued that under such circumstances students would benefit from access to a range of strategies to choose from and test. However, the successful acquisition of new strategies or 'styles' to supplement an individual student's existing repertoire was seen as unlikely if they were allowed to use only their established 'habits of learning' and so matching may be damaging. The difficulty with this otherwise persuasive argument is that whilst teachers in the present study felt they knew their students' learning styles well (and external inspectors concurred in this, although how they knew this remained unexplained) they appeared not to routinely act on this knowledge to significantly differentiate their practice. It was in some cases difficult to avoid the conclusion that this rationale was therefore being offered largely to deflect potential criticism. Outputs from the LSQ and LSI were incoherent and were therefore of little help in these discussions, but were in any case generally discounted by teachers. These teachers had developed a professional practice that was founded on 'what works' and not on educational theory or research. The newly qualified teachers in this study had quickly developed their classroom approach in response to mentoring provided by more established colleagues in their school and longer-serving practitioners recollected that this had also been their experience (Alger, 2009). The transfer of emphasis and time spent within teacher education and training in the UK in recent years away from academic and theoretical study to one more located in practice in schools has perhaps weakened the influence of the former to the detriment of the latter. Several long-serving teachers in the present study commented on this and one remarked that "over the years I've seen teaching becoming more like a technician's job". The dominant influence of a utilitarian, 'craft' approach to education and the associated divergence of research and the practice of teaching has a well documented history in the UK (Alexander, 2008), but the disconnect between research, policy and classroom practice also appears to be an international phenomenon (Hattie, 2009).

The more teachers' implicit use of learning styles was probed in interviews, the clearer it became that they felt that the vectors identified above between them created so much pressure and so many tensions that they had insufficient capacity for addressing anything else. Their professional lives appeared to feature a lot of reactive activity servicing imposed government and school policies and procedures or to include behaviour deliberately designed to deflect potential criticism from different stakeholders advancing multiple agendas. During interview almost all of the teachers in this study voiced something similar to the response of one with long experience who mourned the erosion of teacher identity and authority brought about by "the pressure to get through content, the lack of time to work with individual students, the nonsensical imposed 'standards' and 'league tables', and worrying about how I'm going to get through the million things I'm supposed to do as teacher, social worker, moral counsellor, and results-crammer – everybody now seems to be entitled to tell you not just what to do but how to do it and when. Nobody's really very much interested in *your* expertise or experience or what *you* think and after teaching for forty years I find that rather sad."

It seems inevitable that so long as schools and their teachers are judged by imposed tests, bound by prescribed curricula and subject to official mandates about educational 'best practice' within a highly centralised framework of educational policy and are rewarded and punished accordingly, teachers will adopt the rational if perhaps undesirable strategy of teaching to the tests. Most teachers in this study recognised this as their situation and regarded it as regrettable, educationally unsound and damaging to their profession but felt powerless to change it. Their use of learning styles was a response to the imperatives of policy, to moral panics in the mass media fuelled at times by political dogma or electioneering and to imposed external inspection regimes, many of which arguably have limited support from research (Hattie, 2009). Given the multiplicity of external drivers perceived by teachers in this study, their lack of engagement with educational research or its theoretical underpinnings may be regrettable but unsurprising.

Taken together, pressures from the six vectors identified here appear to strongly mediate the influence of research findings about learning styles on these teachers' classroom activity and lessen the likelihood that they will come to significantly affect their current or future classroom management and pedagogy. However, the use of learning styles by schools and teachers in this study is also symptomatic of a deeper disconnect between educational research and professional practice in the UK. If repairing this is deemed to be desirable it may require changes not only within and between institutions involved in teacher education, but also to the content and focus of professional preparation and to the way policy and assessment regimes are constructed and inform public debate about what we want, and how we assess what we are getting, from

our schools. Studies similar to the present one might usefully be conducted in alternative subject and national settings to establish the extent to which the present findings may be generalised and the manner in and degree to which each of the identified external loci of control influence educational decisions by other educators about how to operationalise individualised learning.

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Does instructional format really matter? Cognitive load theory, multimedia and teaching English Literature

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This article reports a quasi-experimental study on the effects of multimedia teaching and learning in English Literature – a subject which places high cognitive load on students. A large-scale study was conducted in 4 high-achieving secondary schools to examine the differences made to students' learning and performance by the use of multimedia and to relate this to different kinds of multimedia. Statistical significance and effect size calculations indicated that the equivalent of one grade level in General Certificate of Secondary Education (GCSE) was associated with the use of advanced and integrated multimedia, and that this was stronger than the effects of schools and sex of the students. It was found that advanced multimedia software eased cognitive overload, particularly in the area of intrinsic cognitive load. Limitations of the study are drawn, including the needs to examine process variables and learner-related variables. Conclusions and implications for further research and for enhancing teaching and learning with multimedia are made.

Keywords: multimedia; cognitive load; effective education; pedagogy; English Literature

Introduction

The use of multimedia is argued to have the potential to significantly improve instructional efficacy, particularly with regard to the successful learning of information and the development of understanding (Mayer, 2008; Miller, Chang, Wang, Beier, & Klisch, 2011), but concerns persist about the degree to which its design and use have realised or optimised such potential (Argyris,1976; Massa & Mayer, 2006; Schnotz & Kürschner, 2007; Sweller & Chandler, 1994; Tabbers, Martens, & Van Merriënboer, 2000). The application of cognitive load theory (CLT) (Sweller, Van Merriënboer, & Paas, 1998) has been at the forefront of much experimental work in this area, and it articulates important implications for optimising the design of educational multimedia (Mayer, 2003, 2009; Mayer & Moreno, 2002).

This article reports an experimental empirical study of the use of multimedia in the teaching of English Literature and the effect of its use on scores from a measure of knowledge and understanding of Shakespeare's *Macbeth*.

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Cognitive load theory

Cognitive load theory (CLT) seeks to explain why some material is more difficult to learn than other material (Chandler & Sweller, 1991). It is based on the proposition that the human brain uses two types of memory: short-term and long-term memory, where short-term memory is seen as having limited storage capacity and long-term memory is seen as having almost unlimited storage capacity (Sweller, 1994). CLT proposes that the existence of these two types of memory in humans is important because it determines and has been determined by the way we learn. Using short-term memory, we develop *schema* (e.g., cognitive constructs, organised knowledge, or classifications of problems into categories: "cognitive constructs that incorporate multiple elements of information into a single element with a specific function" (Paas, Renkel, & Sweller, 2003, p. 2)) and store these in long-term memory. Schema help us with tasks such as solving problems that we have not seen before by using our learning about similar kinds of problems we have solved in the past. With practice, using our schema can speed up problem solving and task execution by partially automating our cognitive activity when responding to situations or problems that are similar to ones we have learned about in the past. We use the limited capacity of short-term memory to manipulate existing schema (or to create new ones) and apply these to the solution of problems which would otherwise prove too complex for us to deal with if we always had to begin from first principles.

CLT argues that whether some material is easier to learn than other material depends in large part on the degree to which we are able to reduce the amount of processing (cognitive load) needed to solve a problem or learn something new by using schema acquisition and automation: "schemas effectively increase the amount of information that can be held in working memory by chunking individual elements into a single element" (Sweller, 1994, p. 299). "Chunking" is thought to be a common feature of the way short-term memory operates to organise information when constructing schema (Chase & Simon, 1973). Neuroscience speculates that cognitive load may be directly linked to physical "memory load" as a result of the way the brain coordinates the firing of neurons, but this phenomena is not well understood as yet and alternative mechanisms have also been proposed to explain how chunking may be handled in working memory (O'Reilly, Busby, & Soto, 2003).

CLT identifies a number of key factors which, independently, can increase the cognitive load on a learner (or can produce unhelpful types of cognitive load), when dealing with inherently complex material or when confronted by poor instructional design. Given the arguments that learning with multimedia can be more efficient and effective, a consideration of both of these latter factors is important.

In contemporary CLT, three expressions of cognitive load are understood to operate. *Extraneous cognitive load* is the difficulty, or load on the learner's working memory, associated with the design of instructional materials and the way these present information to the learner. High extraneous cognitive load is harmful to learning and is created as a result of unnecessary processing caused by the instructional design. *Germane cognitive load* is the load that is directed towards constructing, processing, and automating schemas. It can also be manipulated by the instructional design but is helpful to learning because it results from features of the design which direct attention towards relevant learning processes. *Intrinsic cognitive load* is directly attributable to the inherent complexity or difficulty of the material to be learned and may not be changed by the teacher; it is assumed to be unaffected by the instructional design and to be the product of a combination of the learner's prior

knowledge and the intrinsic complexity of the learning material (Sweller & Chandler, 1994).

Researchers in the field of CLT attempt to arrange the instructional control of cognitive load so as to optimise the load experienced by subjects in learning situations. The distinction between optimising, as opposed to maximising or minimising, is important and is commonly misunderstood. The aim of cognitive load researchers is not simply to reduce the overall cognitive load on learners, as is sometimes incorrectly assumed, but to avoid extreme situations where there is too little load or too much load, because learning deteriorates in both situations (Young & Stanton, 2002). Cognitive load researchers wish to produce both the optimum amount of load for learning and to promote load *of the right kind*; that is, they seek to optimise the load that contributes to learning (i.e., germane load) and reduce the load imposed by elements that hamper learning (i.e., extraneous load).

When learners find instructional tasks easy (e.g., when intrinsic load is low), any extraneous cognitive load imposed by the learning resources or context may have little or no significant negative effect on learning. This is not the case when tasks are more difficult and the intrinsic cognitive load is high; under these circumstances, it is important to take account of (and if possible reduce) the extraneous load on learners (Van Merriënboer & Sweller, 2005).

However, in some learning situations it may be difficult to reduce the intrinsic load on learners because the learning tasks may be very complex, they may have unavoidably high-element interactivity, or may require the development and application of many different schema, such as in situations where multiple choices are available to the learner regarding the information to be selected and applied. This would be the case in the example given below concerning English Literature, where evidence and judgement about the personality and interactions of a dramatic character are being selected and combined.

Research using CLT has sought to find ways to manage high intrinsic cognitive load (Pollock, Chandler, & Sweller, 2002) by approaches that take account of learner's prior knowledge (see Kalyuga, Ayres, Chandler, & Sweller, 2003) or that allow for the level of germane load imposed on learners by different instructional materials (Cierniak, Scheiter, & Gerjets, 2009; Kalyuga, Chandler, & Sweller, 1998; Salomon, 1984).

When considering the design of resources that teachers may use to promote learning, CLT argues that the physical integration of multiple sources of information is generally beneficial for learners. Physical integration happens when, for example, text and images are combined in multimedia applications or on the page of a textbook so that each does not simply replicate the content contained in the other. Physical integration eliminates the need for learners to split their attention between (for example) physically separate illustrations and text on a page or screen when learning material. Where physical integration has not happened, the learner's attention is divided unhelpfully between the separate elements, as they attempt to process each one individually and make cognitive associations between them. This *split-attention effect* is regarded as unhelpful for learning because it increases extraneous load, and so learning materials featuring split-attention may overwhelm working memory capacity (Chandler & Sweller, 1992; Sweller, 1994).

However, subsequent studies have found that in any given subject domain, certain learning resources which are beneficial for less expert learners become disadvantageous as learners become more expert (Kalyuga et al., 1998).

In particular, the physical integration of information as a means to minimise the split-attention effect becomes less helpful to learners as their expertise grows, and it becomes counter-productive for learning as expertise increases still further (Kalyuga et al., 1998).

For more expert learners, the physical separation of information can be more advantageous than its integration, because they are likely to already possess the schema that the learning resources are attempting to promote in less experienced learners. As a result, learning resources may become subject, therefore, to an *expertise-reversal effect*. The expertise-reversal effect appears when more expert learners find it easier to handle complex instructional material but more difficult to learn from material that is designed to integrate separate elements in order to aid less experienced learners to construct appropriate mental representations (schema); in such cases, experienced learners are confronted with instructional guidance that is redundant for them, and this can be difficult to ignore, thus increasing cognitive load and reducing the efficiency of their learning (Kalyuga et al., 2003). Intrinsic cognitive load can therefore be determined only in the light of reference to a particular level of expertise (Schnotz & Kürschner, 2007).

Obtaining measures of individual cognitive load from learners can be problematic, not least because learners, faced with a new topic or domain, may find it hard to know whether any difficulty they experience is due more to the content or to the instructional design. In such circumstances, it can be difficult or impossible to identify reliably and disentangle the origins of extraneous and intrinsic cognitive load (Cierniak et al., 2009). As a result of either one or the other being higher or lower for different learners, the *overall* cognitive load for different learners may be equally high. However, being able to take due account of the intrinsic load of learning tasks when using instructional multimedia is of importance for educators who are interested in managing such resources to obtain the greatest learning gains for individuals.

Because intrinsic load varies not just as a result of the inherent complexity of the learning material but also with the expertise of the individual learner in that subject or content area, establishing the intrinsic load for individual learners is important for maximising their learning. However, the measurement and management of intrinsic cognitive load can be problematical, not least because objective measures are difficult to obtain and subjective measures, whilst easier to obtain, are not without their own difficulties.

One of the main problems with subjective (i.e., self-report) instruments in general is attributable to what Argyris described as the difference between *espoused theory* and *theory in use* (Argyris, 1976), that is, the difference to be found between what individuals say they do and what they actually do. Learners may identify a particular approach to, or difficulty with, learning as the one they most frequently use or experience, but unless this is verified experimentally or by other means, we are unable to determine the accuracy of such reports, and a learner may well employ entirely different strategies (or experience entirely different difficulties) in practice from those they consistently report in good faith on questionnaires or during interview. This problematic limitation of instruments employing self-reporting (see Veenman, Prins, & Verheij, 2003) has also been identified with regard to the use of instruments proposed for measuring cognitive load. This becomes particularly problematic when cognitive load varies as a result of the learner's changing framework of reference and increased schema acquisition in response to the course

of learning (i.e., as learner expertise increases), because the difficulties that are perceived by the learner and the associated degree of helpfulness of particular resources may be continuously changing as learning proceeds (Schnotz & Kürschner, 2007).

Research on multimedia and learning has demonstrated learning improvements in areas such as science (Moreno & Mayer, 1999; Zheng, Yang, Garcia, & McCadden, 2008), management (Passerini, 2007), chemistry (Lee, 2007; Su, 2008), physical education (Vernadakis, Avgerinos, Zetou, Giannousi, & Kioumourtzoglou, 2006), audio engineering (Cochrane, 2007), history (Williams, 2009), and physics (Stelzer, Gladding, Mestre, & Brookes, 2009). The present study turns its attention to the little-explored area of multimedia use in learning and teaching in English Literature within the UK secondary school curriculum, but the article argues that its ramifications extend to other contexts.

Cognitive load theory and English Literature teaching and learning

Teachers of English Literature in the UK generally seek to encourage the growth of a number of broad skills and abilities in their students as part of their preparation for public examinations such as the Standard Assessment Tests (SATs), the General Certificate of Secondary Education (GCSE), or Advanced Level studies (GCSE Advanced Levels), whilst also taking into account the requirements of the relevant examination board, as set out in its subject syllabus. Desired outcomes for dramatic works or novels, for example, are likely to require students to demonstrate:

- Recall of a sequence of events (the story or plot) in their correct sequential order;
- Understanding of the structure of the narrative;
- Recall of the names of and family relationships between characters;
- Insight into the individual characteristics and traits of characters;
- Knowledge of the dramatic relationships between characters;
- Awareness of the main themes and images present in the work;
- Recognition and understanding of the dramatic structure of the text;
- Understanding of how dramatic elements (e.g., themes and imagery) interact to create meaning and reveal insight;
- Understanding of how each dramatic character is developed;
- Understanding of historical or social influences;
- Understanding of the human condition including spiritual, moral, ethical social and cultural issues.

(Assessment and Qualifications Alliance [AQA], 2011a; Edexcel, 2010)

In order to achieve high levels of performance in public examinations, regulatory bodies expect students to master and display knowledge, understanding, insight, and appreciation of this kind (AQA, 2008, 2009; Edexcel, 2011). To facilitate the development of such learning, teachers commonly draw upon personal enthusiasm and make use of their instructional skill to encourage the high levels of student motivation and engagement which are normally necessary to develop the close familiarity with the text and the critical thinking and analytical skills which are needed. As part of this, teachers often make use of a range of techniques and resources to encourage and promote learning.

Despite such efforts, students often find the study of English Literature difficult because of the inherent complexity of the subject matter and the ways in which this is expressed, where many elements may be closely interrelated and because, as part of their preparation for examinations, they often have to be able to apply their learning to alternative contexts, such as when discussing the contribution of one character or element of a literary or dramatic work to the other specific elements or structural features of that work, or to those of a different literary work, for example, one created by the same author or by a different author writing about a similar theme or context (Council for the Curriculum Examinations and Assessment [CEA], 2010, 2011; Edexcel 2008, 2009, 2011). Achieving high examination results in English Literature requires students to display knowledge, understanding, and insight that can be gained only by effectively memorising, analysing, and synthesising many pieces of information, that is, many discrete interacting elements (AQA, 2011a; Edexcel, 2010).

According to CLT, the processing of information in human cognition takes place within a limited working memory (Baddeley, 1992), and so there exists the physical capacity to handle only a very limited number of novel interacting elements at one time, possibly as few as two or three (Paas et al., 2003). Different information varies across a wide spectrum, from high-element interactivity to low-element interactivity, depending on the subject and the level of complexity of the actual content. The importance of this for learning is that whilst an element of low-interactivity material can be learned and understood individually (because it does not require consideration of other elements), this is not the case for high-interactivity material such as that commonly found in the subject matter of English Literature courses.

Learning the names and activities of the characters in a novel or play provides an example of low-element interactivity because each can be learned and understood without reference to any other items. This task imposes a relatively small cognitive load and may be handled easily. By contrast, learning how to describe the contribution of any of these characters to the dramatic structure and meaning of the work as a whole provides an example of high-element interactivity. Similarly, arguing how one character may be seen in a positive or negative light cannot be done independently of other characters and events in the dramatic work, because reaching a conclusion on this requires knowledge and understanding of events, ideas, and other characters and of how these all relate to each other; that is, the elements required for consideration interact.

The separate elements of high-interactivity material can be learned individually, but understanding them requires all of them and their interactions to be processed simultaneously. This can make high-element interactivity material (such as is found in many highly regarded works of literature) difficult to understand, because it can impose a cognitive load that exceeds the processing capacity of working memory (Ginns, 2006).

However, whilst such material may be more difficult to learn, it is clearly not impossible, as evidenced by the successful learning that teachers of English Literature see in students on a regular basis. The way in which human cognition research allows for the learning of high-element interactivity material is by way of long-term memory, which is an extensive store containing large numbers of *schemas*. The store of schemas is subject to addition or revision in the light of further learning or new experiences (Bartlett, 1932; Neisser, 1967; Piaget, 1985). A schema may

consist of a large number of interacting elements which, if they each had to be processed separately, might easily exceed the capacity of working memory.

In the case of the literary illustration above, one example of a schema might be about behaviour, where a number of elements are combined to produce a classification of a character's actions as ''negative'' or ''positive''. Schemas are hierarchical, domain-specific knowledge structures that categorise multiple elements of related information as a single higher order element. In this, they differ from ''constructs'' (as in construct theory) because they: (a) are cognitive rather than emotional or ethical, (b) do not necessarily represent or articulate our core values, (c) do not focus on our key personal relationships, and (d) are relatively easy to modify or change (Kelly, 1995). Controlling the use of schemas requires conscious effort on the part of the learner, but this can reduce with practice to the point where using a schema can become an automatic process rather than a controlled one.

In the present example, the elements being considered about the behaviour of a dramatic persona may include, selectively, characteristics or relationships that are seen as being either ''bad'' or ''good'', ''kind'' or ''unkind'', ''generous'', or ''mean'' and so on. Schemas for these characteristics and relationships can be retrieved from long-term memory and used in short-term memory, meaning that only a small number of elements have to be processed (used) in memory and the use of schemas may become automated so that they can be processed unconsciously to reduce further the load on working memory. According to CLT, it is by these processes that complex material can be handled by human cognitive architecture when it appears to exceed the capacity of working memory.

The purpose of the research

This article reports an experimental empirical study of the use of multimedia in the teaching of English Literature and the effect of its use on scores from a measure of knowledge and understanding of Shakespeare's *Macbeth*. The study was designed to explore the effect of multimedia use on learning using matched groups of students and teachers in four secondary schools and of differing formats of instructional material in multimedia and non-multimedia formats.

This study draws on previous work in which differences in expertise were found to give the largest and most reliable explanation for differences in performance between individuals. This study also took account of Kalyuga et al. (1998), who found that subjective ratings of mental effort, that is, the mental effort associated with learning the instructional materials, was an effective and accurate proxy measure of cognitive load. The present study follows Kalyuga and adopts the use of subjective ratings of mental effort with exemplar learning materials as an ecologically valid and reliable proxy for prior learning (and therefore for a main element of intrinsic cognitive load) when comparing the learning gains of groups which were using either existing or alternative (multimedia-based) approaches to learning, allowing for different levels of cognitive load attributable to the instructional materials.

The present study sought to explore the relationship between the intrinsic cognitive load imposed by different formats of learning resource and the effects of their use on learning gains for individuals in GCSE English Literature classes, in particular the differences made by, and the effects of, using multimedia in teaching and learning the GCSE English Literature syllabus (see below).

Experimental and control groups were compared to explore the degree to which the use or non-use of multimedia resources mediated these gains for learners with similar subject expertise when learning complex and demanding content. The intervention (the multimedia resources) was designed deliberately to reduce the cognitive load on students and was targeted to ease the cognitive load presented by complex material and its associated overload of short-term memory.

The research procedures

Sampling

From the group of 45 secondary schools used by a university in the North-East of England, UK, for placing trainee teachers during the school-based phases of their programme, 19 were selected because, within the previous 18 months, they had been subject to government inspections which in their resulting reports identified them as "good" or 'outstanding".

The designations "good" and "outstanding" by government inspectors carry significant currency within the UK; they are widely used (if contentious) government-endorsed judgements of the quality of educational provision and student performance which lead to associated benefits, including less intrusive inspection in the future. Inspection reports are published online, so praiseworthy inspections are useful to schools in promotional publicity, such as when seeking to recruit the most able and skilled faculty and also to parents when selecting the school they wish their children to attend. As the level of a state school's funding is closely linked to the number of pupils on its roll, increased competition for places at those which are perceived to be most successful ensures that such schools receive maximum income and acquire high status within their community. Inspection judgements are also referenced by the internet search engines of estate agents (realtors) and have a strong influence on the prices that can be commanded for residential property closest to schools judged to be very successful. There is a powerful incentive, therefore, for schools and individual teachers to strive for positive outcomes from government inspections.

Within the group of schools identified, a subset of nine had in common that in their reports their inspection teams had noted that faculty were highly skilled at identifying students' individual learning needs and in meeting them with a range of different, effective, individually targeted teaching and learning resources and strategies. In many other respects, set out below, the schools were broadly similar, despite serving communities providing student intakes of differing average levels of ability.

Inspectors noted in each school that teachers knew and taught their pupils well, had high expectations of them, matched classroom activity well to their needs, succeeded in having pupils make effective use of a wide range of research skills, were adventurous and imaginative in their teaching, and used a variety of teaching and learning styles effectively. Inspectors also commented that achievement in external examinations was good and that teachers knew how to match their teaching styles and learning materials effectively to pupils' different requirements.

From this subset of nine schools, four were selected for the present study on the grounds that they had well established English faculty who made relatively limited use of information technology in their approaches to learning and teaching.

Technology use by the English faculty of these schools was largely confined to the use of Microsoft Office applications for word processing (e.g., for the production of student assignments) and for information retrieval, where teachers would access syllabus information from government websites or where, under their direction, students would print lesson support material (e.g., worksheets) from online repositories. None of the English departments in these schools made use of other computer resources or multimedia applications to support the learning of students or the teaching of faculty staff.

Participants in these four schools were divided into those replacing some of their normal English lessons with sessions where they used multimedia (the experimental group) and those having ''normal'' (non-multimedia) lessons (the control group); in School 1, each of these groups consisted of 133 students, in School 2 there were 100 students, in School 3 there were 102 students, and in School 4 there were 59 students (Table 1).

Existing teaching groups in the four schools were used to create a more natural teaching and learning setting for the half-term intervention than the strictly randomised groups that might feature in a fully experimental study; this also eased school timetabling difficulties. The study also adopted a quasi-experimental design, with equal numbers of experimental and control groups (classes) for each teacher. These groups were used to explore the effect on learning of multimedia use in teaching the GCSE English Literature syllabus (see AQA, 2008, 2009; Edexcel, 2011; Qualifications and Curriculum Development Agency [QCDA], 2012).

Controls

Equal numbers of teaching groups and participants came from a number of existing classes in these schools, such that for any given subject teacher, the same number of classes they taught appeared in the multimedia (experimental) and non-multimedia (control) group (Table 1).

It is generally not possible to create full experimental conditions in field studies such as that reported here, mainly for practical reasons of securing the willing participation of schools and also for ethical reasons, such as if considering administering an intervention thought to be unhelpful or of no benefit. However, a number of elements could be controlled reasonably well: Experimental and control groups were matched for age-range and performance to date to give a representation of ''more able'' and ''less able'' students (as determined by the school's assessment

Table 1. Composition of sample (M = male, F = female, Exp = experimental groups, Ctrl = control groups).

		Sex		Groups		
		M	F	Exp	Ctrl	Total
School	1	128	138	133	133	266
	2	98	102	100	100	200
	3	0	204	102	102	204
	4	55	63	59	59	118
Total		281	507	394	394	788

and "setting" arrangements) and as far as possible for numbers of males and females (except in School 3, which was all-female).

Within these constraints, classes were randomly selected for participation as far as possible (within the limits of the number of classes available in each school). Classes from each school were involved in the study for the same number of weeks (generally a complete half-term), for whole lessons at a time (around one hour in the case of each school), and in terms of the examination being studied for and the syllabus being followed. Teachers were all established in their school and very (but not identically) experienced in teaching their subject to the relevant examination level (GCSE) and were asked to make no changes to their existing teaching strategies and the resources they customarily used, except for the occasions when the experimental groups used multimedia resources. No controls were imposed for teacher gender, differences in teacher attitude towards multimedia or familiarity with computer use, and comparative measures of teaching strategy when using or not using multimedia were not undertaken.

The experimental groups used a specially developed multimedia application in their English Literature classes for approximately one hour (one lesson from their allocated two) per week over 10 weeks. This application covered the syllabus-relevant content for the text being studied. The control groups studied the identical content to the experimental groups during their English Literature classes (and in the same sequence and time period), with the same teacher, but they experienced only the teacher's usual approaches to teaching and learning, and they used the learning resources their teacher normally employed.

Each experimental and control group had two lessons per week of around one hour each, with one of these lessons being supplemented by multimedia use for the experimental groups. Teachers in each school were provided with an induction session on the operation and use of the multimedia package to be used. Technical staff in each school worked with the researcher to set up and test the software so that it was available for students on the school computer network prior to use with the experimental group classes and to ensure that access was provided only to those students (through controlling student login accounts) in order to reduce the possibility of students in the non-multimedia groups being able to gain access to the multimedia resource.

The learning resources used by the experimental and control groups were equivalent in terms of the information being conveyed, being closely related to the text and the subject syllabus specifications for the public (GCSE) examination that students were preparing for. The existing paper-based learning resources of teachers included worksheets, summaries of various elements of *Macbeth* (biographies of characters, timelines of events, etc.), drawings, illustrations, sample questions, and worked examples.

The experimental groups had one of their two lessons per week replaced by a laboratory session using the multimedia software, under the direction of their usual teacher. The control group had both of their weekly lessons with their usual teacher but had no contact with the multimedia resource used by the experimental group, although no measures were taken to prevent the two groups discussing their classes with each other, as this was impractical and could have risked inadvertently invoking the Hawthorne Effect. For each teacher, the control group(s) followed the same sequence of content study in their classes as those in the group(s) which were using multimedia.

The content of the English Literature software

A networkable multimedia application was provided for each school to support individual and group learning about Shakespeare's play *Macbeth*. The application was from a series of computer programmes created to support the study of a number of individual English Literature texts. Each of these applications contained text, sound, graphics, animation and interactive context-sensitive elements and graphically rich interface designs which provided the student with access to relevant information, support, and learning resources which they could choose to operate in either a 'teaching' or 'testing' mode as desired.

The content of the multimedia resources covered: the text and its main literary sources; interpretations and explanations of dramatic structure and style, characters, themes, images and language; an interactive presentation of the text itself (if free of copyright) together with features allowing for its study, interrogation, and understanding; relevant cultural, scientific, and philosophical background to the text and for the historical period; chronological sequences and explanations of the plot and main subplots; explanatory photographs, charts, diagrams, and maps for relevant locations and events; and biographical information about the author as related to the text.

For each area of content, the resources provided a range of questions in different interactive formats (closed, open ended, cloze, true-false, multiple choice, odd-one-out, etc.) that incorporated feedback to correct, partially correct, and incorrect answers. Feedback to question answers was designed to promote further learning by offering affirmation, reinforcement for correct answers, further learning, suggestions, prompts, and hints or a factual answer, and it often also directed the learner to another area of the resource for additional help or information and to specific locations within the physical text being studied.

The Shakespeare title was selected above others after consultation with faculty because they felt that *Macbeth* provided a particularly suitable challenge for many learners in terms of its mature thematic content, its subtlety of characterisation and imagery, its cultural specificity (historical setting), and its complex language containing multiple layers of meaning. Faculty agreed that *Macbeth* was typical of subject matter that imposed on learners unavoidably high intrinsic cognitive load and was commonly seen by learners as "difficult".

The multimedia application was custom-built to the common design template that was used for the series from which the resource was taken. Packages in the series were available for a number of the most popular texts prescribed for use in many examinations at Key Stage 4 (K11-K13): George Orwell's *Animal Farm*; Charles Dickens' *Great Expectations*; William Golding's *Lord of the Flies*; Shakespeare's plays *Macbeth* and *Romeo and Juliet*; John Steinbeck's *Of Mice and Men*; Mildred D. Taylor's *Roll of Thunder, Hear My Cry*; and Harper Lee's *To Kill A Mockingbird*.

Each multimedia package contained a range of resources for exploring and understanding content and for the teaching and testing of many elements within the literary work, including its story (or plot), language, characters, themes and imagery, its dramatic structure, and its cultural context. These computer resources covered similar areas to the non-multimedia resources used by teachers in the four schools, but, additionally, included interactive multimedia features such as: spoken commentaries accompanying illustrations; interactive maps and timelines about the story; interactive audio translations of archaic or specialised technical language;

hyperlinks between the text and explanations of relevant cultural background or links to similar themes or images; and discussions or definitions of relevant dramatic features or ideas, as well as pre-programmed feedback responses (such as context sensitive responses to questions answered) in a graphic user interface featuring pictorial menus and icons designed around screens with interconnected elements.

Instrumentation

Previous studies have used subjective mental effort ratings to measure overall cognitive load (see Paas, 1992; Van Gog & Paas, 2008) and found that learners who experienced the same overall cognitive load achieved different learning outcomes (Tabbers et al., 2000). This may be due to increases in extraneous load being accompanied by decreases in germane load with some learning formats and vice versa with other learning formats, or to the prior learning of students, or their intrinsic abilities or interest in the topic.

To test whether differences in learning outcome are caused by germane load attributable to the format of instructional materials, a closer measurement of cognitive load is required. Using the text of *Macbeth* as the target area of study, differences in the extraneous cognitive load imposed by two different instructional designs were explored with one set of groups using multimedia (experimental) and another (control) using teachers' established, routine approaches to teaching the same subject matter. It was expected that the germane load imposed on students by these different approaches could therefore vary. A measure of prior knowledge was used to allow for individual differences in intrinsic cognitive load attributable to learner expertise.

Subjects were asked to record how difficult it was for them to learn using different resources, by rating the ease of learning (i.e., mental effort) they associated with different instructional materials for the plot, characters, and themes and imagery on a 5-point Likert-type scale from 1 (*extremely easy*) to 5 (*extremely difficult*). For practice, subjects rated 23 exemplar teaching resource materials for a non-Shakespeare title, representative of the repertoire of resources used by teachers in the four schools, for the degree to which subjects found them easy to learn from; they also similarly rated 32 elements from a non-Shakespeare multimedia title from the same series as the *Macbeth* resource.

Teachers within the four schools checked their existing and the multimedia resource content against a collectively constructed measure of knowledge and understanding which was applied pre- and post-intervention to ensure that measures of relative change in scores could be meaningfully used for both experimental and control groups and that the test included measures of knowledge and understanding that could be gained equally from all resources.

The test was a 30-item paper-based assessment that was completed individually by participants in the normal class session immediately preceding the start of the intervention and before the study of the selected text began. There were 10 questions about key characters in *Macbeth*, 10 about important themes and images found in the play, and 10 about its structure and cultural context. Each section of the test included questions in open-ended, multiple-choice, and short-essay formats. The post-test used this same instrument and was completed under the same conditions 10 or 11 weeks later (variations being due to differing lengths of half terms between schools).

In order to minimise the possibility of a Hawthorne Effect, where an increase in "productivity" (scores on the knowledge and understanding test) could be produced by the psychological stimulus of being singled out and made to feel important (Franke & Kaul, 1978), students using the multimedia application were told that this was simply one of several resources used for studying the text, that they may or may not find it useful but that, by itself, it was not expected to make any real difference to their learning, as this would be mainly the result of how hard they worked in class and on their homework study tasks. Students were not informed of their results from the pre-test, or that the test would be re-used at a later date.

Results

Overall results and results by school

Table 2 presents the overall results of the pre-test and post-test, for all the schools combined and for each school.

Table 2 indicates that the mean difference between the scores of the experimental groups (multimedia) on the pre-test and the post-test were statistically significant ($\rho = .000$). Similarly, the mean difference between the scores of the control groups (non-multimedia) on the pre-test and the post-test were statistically significant ($\rho = .000$). In other words, both the experimental and the control groups recorded statistically significant increases in their scores between the pre-test and the post-test.

Table 2 indicates that the experimental groups recorded a higher *difference* than the control groups in the gains made in their scores between the pre-test and the post-test. Whilst the experimental groups recorded a mean gain of 21.48 points, the control groups recorded a mean gain of 19.07 points.

The post-test difference, after removing the natural maturation, is calculated thus: {Experimental group post-test minus pre-test} minus {Control group post-test minus pre-test} = {27.04 − 5.56} minus {24.63 − 5.56} = 21.48 − 19.07 = 2.41. In other words, the difference in the mean gains between the two groups was 2.41, that is, an 8.03% difference.

For the pre-test, no statistically significant difference was found between the overall means of the experimental and control groups ($\rho > .05$), that is, they were matched at the start of the experiment), whereas for the post-test the difference between the overall means of the experimental and control groups was highly statistically significant ($\rho = .000$).

A measure of effect size (using Cohen's *d*) of the difference between the experimental and control group on the post-test yielded an effect size of $d = .896$, which is a moderate to strong effect. Using another calculation of effect size – partial eta squared – this yielded an effect size of $\eta_p^2 = .185$, which is a moderate effect. For the mean difference between pre-test and post-test intervention scores (a measure of gain), the partial eta squared yielded an effect size of $\eta_p^2 = .989$, which is very strong (Cohen, 1988).

In reviewing the measures of statistical significance and effect size, then, the difference in scores for knowledge and understanding of Shakespeare's *Macbeth* of the groups using the multimedia resource, as compared to the scores of students who did not use the resource, was highly statistically significant and produced a moderate to strong or very strong effect, depending on the measure used. However, the size of an effect, which is often more informative and for practical purposes more relevant than a statistical correlation, also needs to be distinguished from its *importance*. It is

Table 2. Pre-test and post-test results for all schools combined, and for males and females.

Pre-test and post-test results for all schools		Means of all schools combined	School 1	School 2	School 3	School 4
Multimedia (experimental) group	Pre-intervention score	5.13	5.87	5.83	5.53	5.56
	Post-intervention score	27.02	27.00	27.04	27.19	27.04
	Difference between pre-and post-intervention scores (Mean gain)	21.89	21.13	21.21	21.66	21.48
	Significance level (difference between pre- and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$
Non-multimedia (control) group	Pre-intervention score	5.13	5.87	5.83	5.53	5.56
	Post-intervention score	23.95	24.89	25.17	24.83	24.63
	Difference between pre-and post-intervention scores (Mean gain)	18.82	19.02	19.33	19.30	19.07
	Significance level (difference between pre- and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$
Relative increase in scores (experimental compared to control group)		2.41	3.07	2.29	1.88	2.36
Equivalent percentage increase in scores (experimental compared to control group)		8.03	10.23	7.63	6.27	7.87

necessary to consider what these effect sizes mean in terms of the units of measure of the original variable which, in this case, is the improvement in knowledge and understanding that relates to the subject syllabus for an external examination.

Grades for GCSE examinations in the UK are allocated using bands of marks with different ranges delimiting the grades at Higher or Foundation levels and the boundaries for ranges vary slightly between Examination Boards; those referred to here reflect the syllabus in use in the four schools. Table 3 indicates the grade boundaries used in the GCSE examinations.

The results reported here therefore indicate that teachers, by making use of the multimedia resources discussed, could have improved their students' average performance in English Literature by a margin in excess of one GCSE examination grade.

Though these gross differences were found in combining the results from the four experimental groups and in combining the results from the four control groups, nevertheless differences were found between each of the experimental groups in each of the four schools and between the control groups in each of the four schools. Table 2 indicates where the difference lay between the four schools.

To ascertain whether there were any statistically significant differences between the schools at the pre-test stage, Analysis of Variance (ANOVA) and the post-hoc Tukey test were conducted on the four experimental groups and on the four control groups. ANOVA found that there was a statistically significant difference between the four schools at the pre-intervention (pre-test) stage for both the experimental and control groups ($F = 3.950$, $\rho = .009$). The Tukey test found that the means for the four schools were statistically significantly different at the pre-intervention stage with the mean for School 1 being relatively low (5.13), which was some distance away from the next lowest mean of 5.53 (School 3).

At the post-test stage, ANOVA found that the means for the four Schools in the experimental (multimedia) group were not statistically significantly different ($\rho = 0.966$), whereas in the control (non-multimedia) group the means were statistically significantly different ($\rho = .003$), with the mean for the control group in School 1 (23.95) being some distance away from the next lowest mean (School 4: 24.83) and with the mean for the control group in School 3 being some distance away from the next highest mean (School 2: 24.89). Though one can see improvements in all the schools and for both the experimental and control groups, Table 2 suggests that School 4 made the greatest difference to both Groups 1 and 2, though these were only a little higher than those in the other three schools.

A closer inspection of the data revealed that statistically significant differences between the mean scores for mixed-sex schools at both pre- and post-intervention stages are largely the product of performance by sex, although there was no consistent direct relationship between sex, an individual school, and the mean gains for multimedia or non-multimedia groups.

Explaining the variability between students within the four schools is of interest, especially for teachers seeking to understand why measures of overall gain varied widely between and within schools. For example, the pre-test mean score for knowledge and understanding was lower for students in School 1 (5.13) – both for the multimedia (experimental) and non-multimedia (control) groups – than for students in any of the other schools, but the use of multimedia in this school produced the largest absolute increase in average scores over the students in the non-multimedia group in all schools (3.07). The use of multimedia in the single-sex school

Table 3. Grades and grade boundaries for GCSE English Literature (AQA, 2011b).

	Maximum Scaled Mark (%)	Scaled Mark Grade Boundaries for 'pass'							
		A*	A	B	C	D	E	F	G
English Literature A Tier H (Higher)	200(100)	171 (85.5)	150 (75)	131 (65.5)	113 (56.5)	93 (46.5)	83 (41.5)		
Range from lower grade boundary		(10.5)	(9.5)	(9)	(10)	(5)			
English Literature A Tier F (Foundation)	200(100)				105 (52.5)	88 (44)	71 (35.5)	55 (27.5)	39 (19.5)
Range from lower grade boundary					(8.5)	(8.5)	(8)	(8)	

(School 3) produced the smallest absolute increase in average scores over the non-multimedia group in any of the four schools (1.88), despite this school having one of the highest overall pre-intervention scores for knowledge and understanding of *Macbeth* for both multimedia and non-multimedia groups (5.83).

These data suggest that the use of the multimedia resource in the four schools improved scores of knowledge and understanding in English Literature substantially beyond those achieved without the resource, but there was no consistent linear relationship between the pre-intervention scores and post-intervention scores (relative gain) of students that used the multimedia resource.

Results by sex

GCSE examination pass rates have continued to rise in the UK over the last 23 years, but there remains a persistent and, in some subjects (especially English), a growing difference in performance between males and females, although at "A Level" this gap is now closing. This phenomenon continues to attract comment in both the media (BBC, 2011a, 2011b; Guardian, 2011; Mail Online, 2011) and in government reports (DfCSF 2007, 2009). The data were therefore processed and analysed by the sex of the students (Tables 4 and 5). The knowledge and understanding assessment was a 30-item test, and the average gains in scores in the four schools ranged from 6.27% (School 3) to 10.23% (School 1), with the highest score being for females in School 1 (11.47%) and the lowest being for males in School 2 (5.47%).

The overall pre- and post-test scores for males and females in the experimental and control groups, for schools, and for males and females within each school were

Table 4. Pre-test and post-test results for all schools combined, and for males and females.

Pre-test and post-test results for all schools		Means of all schools combined	Means of all Males	Means of all Females
Multimedia (experimental) group	Pre-intervention score	5.56	5.44	5.67
	Post-intervention score	27.04	25.51	27.32
	Difference between pre-and post-intervention scores (Mean Gain)	21.48	20.06	21.65
	Significance level (difference between pre-and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$
Non-multimedia (control) group	Pre-intervention score	5.56	5.52	5.58
	Post-intervention score	24.63	24.46	24.73
	Difference between pre-and post-intervention scores (Mean gain)	19.07	18.94	19.15
	Significance level (difference between pre-and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$
Relative increase in scores (experimental compared to control group)		2.41	2.24	2.50
Equivalent percentage increase in scores (experimental compared to control group)		8.03	7.47	8.33

Table 5. Composite table of scores for all schools, by sex (M = male, F = female).

		School 1			School 2			School 3	School 4		
		All	M	F	All	M	F	F	All	M	F
Multimedia (experimental) group	Pre-intervention score	5.13	4.91	5.33	5.87	5.73	6.00	5.83	5.53	5.75	5.32
	Post-intervention score	27.02	26.44	27.55	27.00	26.39	27.59	27.04	27.19	27.04	27.32
	Difference between pre-and post-intervention scores (Mean Gain)	21.89	21.53	22.22	21.13	20.65	21.59	21.21	21.66	21.29	22.00
	Significance level (difference between pre-and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$
Non-multimedia (control) group	Pre-intervention score	5.13	5.39	4.88	5.87	5.57	6.16	5.83	5.53	5.74	5.34
	Post-intervention score	23.95	24.25	23.67	24.89	24.55	25.22	25.17	24.83	24.81	24.84
	Difference between pre-and post-intervention scores (Mean gain)	18.82	18.86	18.78	19.02	18.98	19.06	19.33	19.30	19.07	19.50
	Significance level (difference between pre-and post-intervention)	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$	$\rho = .000$
Relative increase in scores (experimental compared to control group)		3.07	2.67	3.44	2.29	1.67	2.53	1.88	2.36	2.22	2.50
Equivalent % increase in scores (experimental compared to control group)		10.23	8.90	11.47	7.63	5.57	8.43	6.27	7.87	7.40	8.33

examined for differences between the pre-test and post-test, using the *t* test for independent and related samples as appropriate.

On the English Literature knowledge and understanding variable, the results are shown in Table 6. For males the mean score (from a maximum score of 30) for the pre-test was 5.44 ($SD = 1.864$); for the post-test, it was 25.51 ($SD = 2.924$), and the mean percentage improvement between pre-and post-test scores was 66.88 ($SD = 8.565$). For females, the mean score on the pre-test was 5.62 ($SD = 1.927$), and for the post-test it was 26.02 ($SD = 2.720$), with a mean percentage gain of 68.00 ($SD = 7.985$).

Tables 4–6 indicate that, for the pre-test, the results of the males and females did not differ statistically significantly ($\rho > .05$). For the post-test, the results of the males and females differed statistically significantly ($\rho = .015$). There was a highly statistically significant difference between males and females in the sample for the overall pre-test to post-test scores and for the relative measure of learning gain in knowledge and understanding, with females achieving larger gains (8.33%) relative to males (7.47%). A similar pattern obtained in each of the three mixed-sex schools, where females using the multimedia resource gained larger improvement than males using the multimedia resource.

In School 2, females scored higher than males at both pre-test and post-intervention stages in both the control and experimental groups. In School 1, females scored higher than males in the experimental group, but in the control group males scored higher than females, although the mean gain of the experimental group as a whole (22.22) was still greater than that of the control group as a whole (18.78), and a similar situation existed in School 4. In control groups, knowledge and understanding scores improved more for males than females in School 1, but these gains were reversed and equalled or exceeded in size by females in all the other schools.

Females in the single-sex school (School 3) achieved the smallest mean gain for females in the experimental group (21.21) out of all four schools, whilst females in School 1 achieved the largest gain (22.22). School 4 achieved the largest mean gain for females in all schools in the control group (19.50), and School 1 achieved the smallest (18.78). Males in School 2 achieved the smallest mean gain for males in the experimental group in the three mixed-sex schools (20.65), whilst males in School 1 achieved the largest mean gain for males in all schools in the control group (21.53). Overall, School 1 produced the largest mean gain for all students using multimedia (21.89) (i.e., experimental group), and the single-sex School 3 produced the largest

Table 6. Pretest and post-test scores for knowledge and understanding, by sex.

	Sex	*N*	*M*	*SD*	*SE* Mean	Statistical significance between males and females
Pre-test	Male	281	5.44	1.864	.111	.199
	Female	507	5.62	1.927	.086	
Post-test	Male	281	25.51	2.924	.174	.015
	Female	507	26.02	2.720	.121	
Percentage gain between pre-test and post-test	Male	281	66.88	8.565	.511	
	Female	507	68.00	7.985	.355	

mean gain for all students using non-multimedia (19.33) (i.e., the control group), closely followed by School 4 (19.30).

Interaction effects: sex, school, and group

A two-way between-group analysis of variance was conducted to discover the interaction effects of sex, school, and group (experimental or control) on performance in the examination of GCSE English Literature competence. There was a statistically significant main effect for experimental/control group ($F = 200.816$, $\rho < .001$, $\eta^2 = .206$). There was also a statistically significant effect for sex ($F = 6.076$, $\rho = .014$) and for the interaction effect for school * group ($F = 4.350$, $\rho = .005$), but the effect sizes were small (sex ${\eta_p}^2 = .008$; school * group ${\eta_p}^2 = .017$). The interaction effects and effect sizes were also not statistically significant and were small as between school * sex ($F = 0.211$, $\rho < .810$, ${\eta_p}^2 = .001$); group * sex ($F = 146.156$, $\rho < .089$, ${\eta_p}^2 = .004$); and school * group * sex ($F = 8.962$, $\rho < .837$, ${\eta_p}^2 = .000$) (Cohen, 1988). Table 7 indicates that the use or non-use of multimedia was the most important and substantial influence on improvements in learning the course content studied in each of the four schools (${\eta_p}^2 = .206$). Put simply, the multimedia intervention exerted a stronger effect on the post-test scores than either the sex of the student or the school which s/he attended.

Cognitive load and resources

The teaching and learning resources were varied, and cognitive load theory (CLT) suggests that different kinds of resource would make different demands on students. It was important to explore the kinds of demands made on students by the different resources, including those in the multimedia package. To ascertain the nature of the cognitive load and demands made on students using the multimedia resources (the

Table 7. Between-subject effects in a two-way ANOVA: the effect of school, group (experimental vs. control), and sex on percentage gain in pre-test and post-test scores of knowledge and understanding.

Dependent Variable: Percentage gain						
Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	13930.018*	13	1071.540	21.210	.000	.263
Intercept	3.047E6	1	3.047E6	60301.396	.000	.987
School	232.682	3	77.561	1.535	.204	.006
Group	10145.509	1	10145.509	200.816	.000	.206
Gender	306.968	1	306.968	6.076	.014	.008
School * Group	659.376	3	219.792	4.350	.005	.017
School * Sex	21.290	2	10.645	.211	.810	.001
Group * Sex	146.156	1	146.156	2.893	.089	.004
School * Group * Sex	17.923	2	8.962	.177	.837	.000
Error	39103.526	774	50.521			
Total	3.654E6	788				
Corrected Total	53033.544	787				

*R Squared = .263 (Adjusted R Squared = .250).

experimental group), factor analysis was conducted on the data concerning the different kinds of resources that they used.

Further, CLT offers a possible explanation for the lack of a direct consistent relationship found between pre-test scores and post-test scores by arguing that the critical factor in facilitating successful learning is the degree to which cognitive load is optimised and that, as discussed in the earlier part of this article, this is the product of: instructional design (extraneous cognitive load); the effort expended in constructing, processing, and automating schemas (germane cognitive load); and prior learning and intrinsic subject/topic difficulty (intrinsic cognitive load).

Given the parallel instructional resources used by students in the experimental (multimedia) groups in the study, it was deemed reasonable to expect that *extraneous* cognitive load (load associated with the design of instructional materials and the way these present information to the learner) was held constant for these students. *Intrinsic* cognitive load is directly attributable to the inherent complexity or difficulty of the material to be learned and is composed of the combination of the learner's prior knowledge and the complexity of the learning material. For the purposes of the present study, one may assume that the part of intrinsic cognitive load attributable to the complexity of the learning material (*Macbeth*) was also constant for these students, as they were all studying the content of the same literary work. The remaining component of intrinsic cognitive load (prior learning) remains as the important variable; this was measured by reports of individual ratings of mental effort when learning with different resources (which has been shown to be an effective proxy (Kalyuga et al., 1998)).

Following an introductory 2-hr familiarisation period provided by the researcher and the class teacher using an alternative title from the multimedia series of packages, individual subjective ratings of mental effort were obtained for learning with a range of its relevant features and also for learning with a range of exemplar classroom resources commonly used by the teachers from the experimental (multimedia) groups in the four schools, using a paper-based questionnaire and accompanying illustrated workbook. Ratings were used as proxy measures of the intrinsic cognitive load attributable to the learning materials (equivalent to learner expertise) and compared with the learning gains made by individuals within the experimental (multimedia) groups in the four schools.

Twenty-nine different examples of resource were assessed, chosen to be representative of those used by the teachers in the four schools and contained within the multimedia software: (a) text only; (b) text accompanied by a number of graphical features that were integrated with the text; (c) text accompanied by unintegrated graphical features that seemed likely to invoke a split-attention effect; and (d) integrated multimedia elements from the multimedia resource.

Exploratory principal component factor analysis was used to investigate the underlying constructs within the data from the students concerning these resources. It was expected that the mean scores for different individual resources would not all intercorrelate; hence, Varimax rotation was applied to the data, and the rotated component matrix maximised the differentiation of the original variables (different resources) by extracted factor. From the data, four clear components were extracted with Eigenvalues greater than 1.00, and these accounted for 64.489% of the total variance explained.

Small coefficients were initially suppressed in the rotated component matrix at the .50 level, but one item (non-multimedia non-interactive maps – P5 NM Maps)

did not initially appear to load onto any component at this value, but increasing this to an absolute value of below .10 produced an output for P5 NM Maps loading most strongly onto Component 1, and this additional value was therefore added to the output (Table 8).

The four components were entitled thus:

- Factor 1 (Component 1): Non-multimedia text resources that were accompanied by illustration elements that were integrated with the text (22.055% of total variance explained);
- Factor 2 (Component 2): Non-multimedia text resources unaccompanied by other features (16.759% of total variance explained);
- Factor 3 (Component 3): Non-multimedia text resources that were accompanied by illustration elements that were not integrated with the text and which were likely to produce a split-attention effect (15.699% of total variance explained);

Table 8. Rotated component matrix for resources used.

	Component			
Rotated Component Matrix	1	2	3	4
P1 NM Text				.802
P2 NM Text				.812
P3 NM Text				.561
P4 NM Text				.662
P5 NM Maps	.465			
P6 NM Text and illustrations – Integrated	.657			
P7 NM Text and flowcharts – Integrated	.717			
P8 NM Text with icons – Integrated	.661			
P9 NM Text and summary boxes – Integrated	.591			
P10 NM Text and summary boxes – Integrated	.706			
P11 Text with illustrations – Integrated – Integrated	.566			
P12 NM Text with icons and precis – Integrated	.641			
P13 NM Text with icons and precis – Integrated	.648			
P14 NM Text – Integrated	.691			
P15 NM Text and questions and quotations – Integrated	.677			
P16 NM Text with illustrations and icons – Split		.532		
P17 NM Text questions – Integrated	.509			
P18 NM Text with illustrations and icons – Split		.625		
P19 NM Text with illustrations and icons – Split		.663		
P20 NM Text with graphic features – Split		.683		
P21 NM Text with graphic features – Split		.805		
P22 NM Text with graphic features – Split		.735		
P23 NM Text with graphic features – Split		.692		
P24 M Interactive menu screens with Animation – Integrated			.688	
P25 M Images of scenes from the plot with Animation and Voiceover – Integrated			.690	
P26 M Maps with Animation – Integrated			.735	
P27 M Questions with Animation – Integrated			.691	
P228 M Text on background analysis with Animation and Voiceover – Integrated			.775	
P29 M Pictures of historical events/places with Animation – Integrated			.736	

- Factor 4 (Component 4): Multimedia resources with integrated elements such as animation and/or speech (9.976% of total variance explained).

These four factors were scored by students for the degree of difficulty they experienced when using them for learning for each of the factors (on a 5-point scale), by aggregating the means for each of the elements in each factor. The results are reported in Table 9. Researchers in the field of CLT have demonstrated that such scores are reliable proxies for learner expertise and thus for the level of germane load imposed on the learner by instructional materials (Cierniak et al., 2009; Kaluga et al., 2003, 1998; Salomon, 1984). As extreme levels of cognitive load are detrimental to learning (Van Merriënboer & Sweller, 2005; Young & Stanton, 2002), one would expect that variations in scores for these resources would be closely associated with (i.e., would predict) measures of learning gains when controlled for resource type (component). CLT would predict that students who reported that they found a particular resource very difficult to learn with would gain less knowledge and understanding from using it than students who reported that they found the same resource very easy to learn with.

Table 9 indicates that both the experimental and control groups found that Factor 4 – multimedia resources with integrated elements such as animation and/or speech – provided the greatest ease and the lowest degree of difficulty, whereas Factor 2 – non-multimedia text resources unaccompanied by other features – provided the greatest degree of difficulty. Regardless of whether a student was in the experimental or control group, the same progression of ease was found, from hardest to easiest: Non-multimedia text resources unaccompanied by other features was the most difficult, followed, as second most difficult, by non-multimedia text resources that were accompanied by illustration elements that were not integrated with the text and which were likely to produce a split-attention effect, followed as third most difficult (second easiest) by non-multimedia text resources that were accompanied by illustration elements that were integrated with the text, and the easiest was multimedia resources with integrated elements such as animation and/or speech. Clearly, the more integrated and animated were the resources, the greater was the easing of cognitive load, and the use of multimedia (Factor 4) provided the greatest easing of cognitive load (cf. Mayer & Moreno, 2002). When ANOVA and the post-hoc Tukey test were conducted on the four means of the experimental group and the four means of the control group, the mean for Factor 4 was statistically significantly different from the means of the other three factors ($\rho = .008$) for both the experimental and control groups, that is, using the multimedia software made a statistically significant difference to the cognitive load, easing it, for both the experimental and control groups. This was particularly the case for the experimental group, where the mean for Factor 4 (3.64) was substantially lower than that of the

Table 9. The means recorded for each factor.

	Experimental group mean	Control Group Mean
Factor 1	3.81	3.86
Factor 2	3.92	3.92
Factor 3	3.83	3.87
Factor 4	3.64	3.71

control group (3.71) and showed the greatest difference between the experimental and control groups of all the four factors (see Table 9); for the experimental group, the mean for Factor 4 (3.64) was .17 distant from the second lowest score (3.81), and for the control group it was .15 distant from the second lowest score (3.86). Both of these distances are in stark contrast to the distances between the second lowest and the highest scores for each group: .11 for the experimental group and .06 for the control group.

Discussion

The findings from the research are very clear: In the English Literature study, cognitive load was eased by the use of multimedia, and the greatest easing was where multimedia were integrated with animation, audio, explanation, and background analysis. Further, the study indicates that CLT can offer both a useful explanation for the findings, and it can assist teachers of English Literature in planning their teaching, particularly in terms of the resources that they use. The study has indicated that intrinsic cognitive load in English Literature teaching and learning can be rendered more manageable by the use of integrated and advanced multimedia that move beyond text to animation, background materials, and voice-over commentaries.

CLT argues that *germane* cognitive load (the load directed towards constructing, processing, and automating schemas) can be manipulated and optimised by good instructional design in ways that help learning by directing attention more towards relevant learning processes. The findings of the present research show that this outcome was achieved more by the multimedia resources used than by the other resources used and that this benefit was progressive across the different media in line with the expectations of CLT. This finding supports those found in other studies mentioned earlier (Cierniak et al., 2009; Kalyuga et al., 2003, 1998; Mayer 2008, 2009; Mayer & Moreno, 2002; Schnotz & Kürschner, 2007). In comparison to the other (non-multimedia) resources used, including those customarily employed by the teachers in the four schools, the multimedia also produced lower *extraneous* cognitive load on working memory which, if it is too high, is unhelpful for learning and is created as a result of unnecessary processing caused by instructional design. The findings of the present research also show that, because of the above outcomes, the multimedia resource was helpful in moderating the effects of the *intrinsic* cognitive load attributable to the inherent complexity and difficulty of the material to be learned (*Macbeth*) by offering learners who had relatively little prior knowledge of this literary work the integrated resources that CLT predicts will be most helpful in facilitating the creation of the schema required for learning.

Conclusions and implications

The study found appreciable differences in cognitive load between the experimental and control groups and that the use of multimedia was strongly associated with increased performance in important areas of learning most relevant for success in external examinations at GCSE. The effect sizes and statistically significant differences found between the control groups and the experimental groups here were notable, being equivalent to around one grade difference in GCSE results.

Further, statistically significant differences were found within and between the experimental and control groups by sex, with females typically outperforming males. However, the multimedia intervention exerted a stronger effect on the post-test scores than either the sex of the student or the school which s/he attended, and the multimedia showed the greatest difference/distance between the mean scores for other kinds of resource for all the other factors. In other words, the use of multimedia was associated with the strongest differences of all those found.

The use of the multimedia resource in the four schools improved scores in the field of knowledge and understanding in English Literature substantially beyond those achieved without the resource. Using the multimedia software made a statistically significant difference to the cognitive load experienced by students, easing it for both the experimental and control groups when compared to the cognitive load associated with other resources.

That said, caution has to be exercised in interpreting the results here. For example, there were between-group differences in the four schools in terms of the control groups and in terms of the experimental groups, and this suggests that the influence of cognitive load resides not only in external matters, such as the teaching and learning materials used (though clearly they make a significant difference) or the types of materials within multimedia (which the tables will show), but that it also resides within the learners. The ease of learning with any given educational resource may be in part due to the resource itself, or to the prior learning of the individual, but also to a host of other subjective, personal, or biographical factors such as student motivation, student teacher interaction, or student'student interaction, and these other factors cannot be ruled out as having no bearing on the results found, and we cannot be certain that cognitive load is a feature of only ''cognitive'' processes. Further research needs to be done on what these other factors may be and what may be their relative weightings on outcomes.

Further, though controls were exerted wherever possible between the control and experimental groups, this was a quasi-experiment and, being a field experiment, it was not therefore possible to hold some variables constant, that is, to have complete controls in place. For example, it was not always possible to match exactly the control and experimental groups (e.g., one school was single-sex), and random allocation was not possible even though several steps were taken to ensure matching between the control and experimental groups, as discussed in the article. Further research with fuller controls would be valuable here, although caution will be needed to ensure that any outcomes from strictly controlled experimental studies are generalisable.

Finally, the research operates on largely a ''black box'' situation here; it is concerned largely with input and output measures. This does not tell us about the effects of process variables and of variables within the learners (and, as discussed above, subjective factors are relevant in analyses of cognitive load), and these may be important. Hence, the present article not only presents findings but raises questions for further research, especially concerning those process variables and learner-related variables that could be exerting an influence on the situation, which could be researched, for example, through observational studies.

However, despite these limitations, the findings here suggest that educationists who are keen to discover how to make cognitive load manageable, particularly for the teaching and learning of inherently complex matters, will find the use of active and interactive multimedia techniques valuable in easing that degree of cognitive

load which is counter-productive to effective and efficient learning. This article has suggested that cognitive load theory can make a significant contribution to understanding the limiting constraints on students' learning brought about by instructional design and its associated cognitive load and overload, and that cognitive load theory can suggest effective ways of how to reduce and ease these.

Notes on contributor

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